BUREAU OF RECLAMATION

Near-term Colorado River Operations

Final Supplemental Environmental Impact Statement



March 2024

U.S. Department of the Interior
Bureau of Reclamation
Upper and Lower Colorado Basins
Interior Regions 7 and 8

BUREAU OF
RECLAMATION

Mission Statements

The **Department of the Interior** protects and manages the Nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities.

The mission of the **Bureau of Reclamation** is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Photo by Connie Castle, Bureau of Reclamation, 2023, Flickr.com

The water level behind the Hoover Dam on July 28, 2023.

Dear Reader for Final SEIS:

Thank you for your participation and input in developing the attached Near-term Colorado River Operations Final Supplemental Environmental Impact Statement (SEIS). The Final SEIS incorporates public comments on the revised Draft SEIS, which was issued on October 27, 2023 for a 45-day review period. Appendix H documents the review process and contains the substantive comments and responses.

One topic raised in several comments was the effect of recent hydrology, which has been below average for the beginning of water year 2024. This topic is pertinent to the range of alternatives because, as discussed in the revised Draft SEIS dear reader letter, hydrology improvements in water year 2023 were the basis to consider a new range of alternatives. Between the revised Draft SEIS and this Final SEIS, Reclamation reviewed the current hydrology to determine if it warranted changes to the analysis. Chapter 1 of the Final SEIS also addresses enhanced operating risks at low elevations for Glen Canyon Dam, although the hydrology shows reaching these low elevations is unlikely during the remainder of the interim period.

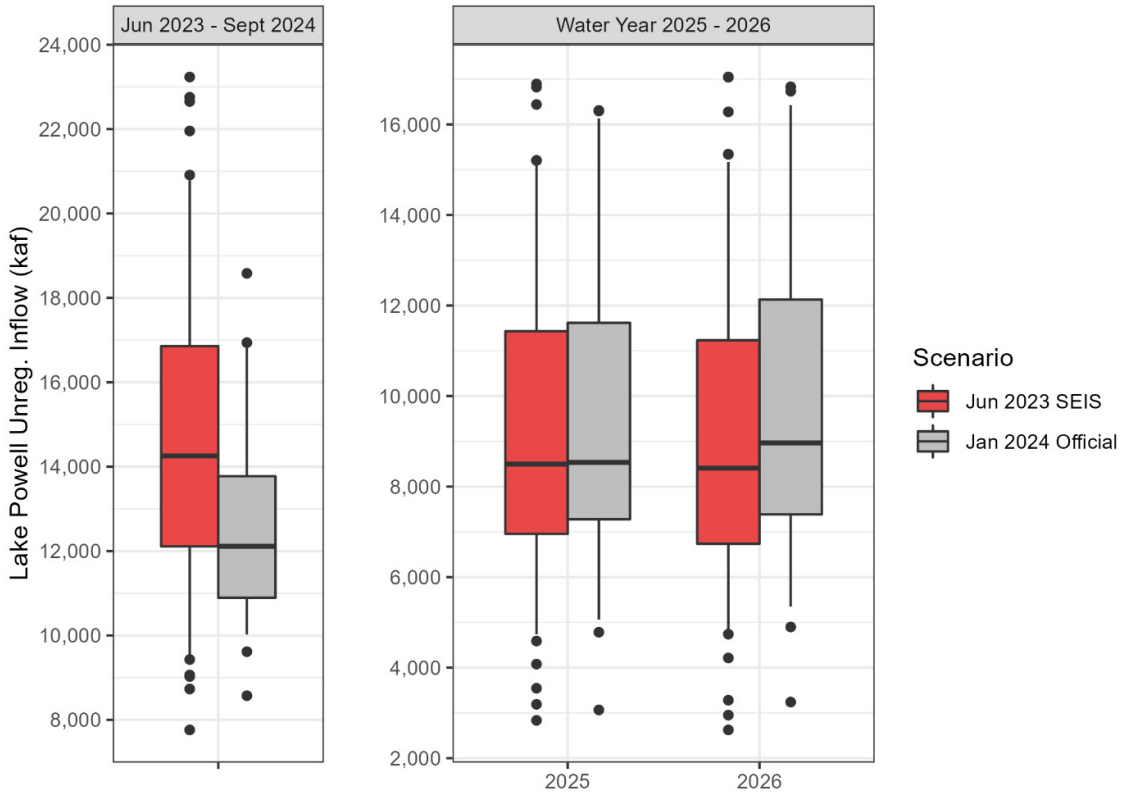
The range of alternatives considered in this Final SEIS is the same range considered in the revised Draft SEIS. While the hydrology forecasts have declined from the projections used in the revised Draft SEIS, which were based on June 2023 data, Reclamation determined that the hydrology used in the revised Draft SEIS analyzed a range of hydrology for June 2023 – September 2024 even drier than the current forecast, as illustrated in the figure.

The figure below shows data used in the revised Draft SEIS compared to the current forecast. The revised Draft SEIS analyzed resource impacts using hydrology from the June 2023 ensemble streamflow prediction (ESP) forecast, which combined the official 100 percent ESP, the 90 percent ESP, and the 80 percent ESP (Jun 2023 SEIS in the figure above). The three sets of ESPs allowed for a wide range of low-flow hydrology scenarios to be analyzed, and these three sets of ESPs are lower than hydrology sequences observed in the last 30 years and lower than the official forecast in June.

The 2024 April through July runoff forecast is below average at 74 percent due to below average precipitation and accumulated snowpack in water year 2024 as of January 17, 2024. Even with the below average forecast from January 2024, the revised Draft SEIS analyzed a range of hydrology for June 2023 – September 2024 even drier than the current forecast. The Jun 2023 SEIS hydrology is compared to the current forecast (Jan 2024 Official) in the figure above. In the left panel, the total unregulated inflows from June 2023 through September 2024 are compared to provide a summary of both what occurred or was modeled to occur in water year 2023 and what could happen in water 2024. The volumes for the Jan 2024 Official forecast include observed flows (June 2023-December 2023), while the Jun 2023 SEIS flows rely on the forecast for this period, including the adjusted ESP scenarios, which have lower flows than the official June 2023 forecast.

Additionally, the revised Draft SEIS analyzed lower minimum hydrology in water years 2025 and 2026 than is included in the January 2024 Official forecast. The right panel compares the hydrologies for the 2025 and 2026 water years.

Revised Draft SEIS Hydrology Compared to the January 2024 Official Forecast
Lake Powell Unregulated Inflow for the Revised Draft SEIS Analysis Period



Based on Reclamation's analysis described here, it is appropriate for the range of alternatives to remain unchanged in this Final SEIS. This Final SEIS, like the revised Draft SEIS, analyzes a range of impacts on resources informed by hydrology that spans the range of flows projected by the current January 2024 Official forecast, and even includes possibilities drier than the January 2024 Official forecast. Because the revised Draft SEIS analyses are not intended to suggest actual probabilities but rather compare performance across alternatives, and because it was intended to analyze operational strategies across a wide range of low-flow hydrologic scenarios, the hydrology used in the June 2023 SEIS is sufficient for these purposes.

Moreover, through the 2024 winter and spring, the forecast will continue to change as snow accumulates in the Colorado River Basin. Updating hydrology modeling every time the forecast changes is neither practical nor would it provide meaningful information to compare alternatives since the revised Draft SEIS resource analysis already considered a wide range of low-flow hydrology scenarios.

Thank you,

Department of the Interior

Final Supplemental Environmental Impact Statement for Near-term Colorado River Operations

Proposed Action: Reclamation is proposing to revise the 2007 Interim Guidelines for the operation of Glen Canyon and Hoover Dams beginning in the 2024 operating year to address the potential for continued low-runoff conditions in the Colorado River Basin. The potential impacts of low runoff conditions in the remainder of the interim period (prior to January 1, 2027) pose unacceptable risks to routine operations of Glen Canyon and Hoover Dams; therefore, modified operating guidelines should be expeditiously developed.

Lead agency: Bureau of Reclamation, Upper Colorado Basin Interior Region 7 and Lower Colorado Basin Interior Region 8

Cooperating agencies:
Bureau of Indian Affairs
National Park Service
Western Area Power Administration
US Fish and Wildlife Service
US Section of the International Boundary and Water Commission

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G Table of Sensitive Species
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Acronyms and Abbreviations

	Full Phrase
1944 Water Treaty	United States-Mexico Treaty on Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande
2006 Flaming Gorge Dam ROD	2006 Record of Decision for the Operation of Flaming Gorge Dam Final Environmental Impact Statement
2007 FEIS	2007 Interim Guidelines Final Environmental Impact Statement
2007 Interim Guidelines	Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead
2007 ROD	2007 Interim Guidelines Record of Decision
2012 Aspinall ROD	2012 Record of Decision for the Aspinall Unit Operations Final Environmental Impact Statement
µg/L	micrograms per liter
af	acre-feet
afy	acre-feet per year
AOP	Annual Operating Plan
APE	area of potential effects
Basin	Colorado River Basin
Basin Fund	Upper Colorado River Basin Fund
Basin States	Colorado River Basin States
BCPA	Boulder Canyon Project Act
BIA	Bureau of Indian Affairs
BWSCP	Binational Water Scarcity Contingency Plan
°C	degrees Celsius
CAP	Central Arizona Project
CAWCD	Central Arizona Water Conservation District
CBRFC	Colorado Basin River Forecast Center
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
CLNP	Canyonlands National Park
CNRA	California Natural Resources Agency
CO_2e	carbon dioxide equivalent
Compact	Colorado River Compact of 1922
CRIR	Colorado River Indian Reservation
CRMMS	Colorado River Mid-term Modeling System
CRMP	Colorado River Management Plan
CRSP	Colorado River Storage Project
CRSS	Colorado River Simulation System
CVWD	Coachella Valley Water District

Dam Fund	Colorado River Dam Fund
DCP	Drought Contingency Plan
DCPA	2019 Colorado River Drought Contingency Plan Authorization Act
Department	United States Department of the Interior
Development Fund	Colorado River Basin Development Fund
DO	dissolved oxygen
DROA	Drought Response Operations Agreement
EA	environmental assessment
EC	extraordinary conservation
EIA	United States Energy Information Administration
EIS	environmental impact statement
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
ESP	Ensemble Streamflow Prediction
GCMRC	Grand Canyon Monitoring and Research Center
GCNP	Grand Canyon National Park
GCNRA	Glen Canyon National Recreation Area
GCPA	Grand Canyon Protection Act of 1992
GDP	gross domestic product
GEMSS	Generalized Environmental Modeling System
GHG	greenhouse gas(es)
GIS	geographic information system
GRIC	Gila River Indian Community
GTMax	Generation and Transmission Maximization
GWh	gigawatt hours
HCP	Habitat Conservation Plan
HFE	High-Flow Experiment
IBWC	International Boundary and Water Commission
ICS	intentionally created surplus
IID	Imperial Irrigation District
Indian	American Indians
IPAC	Information for Planning and Consultation
ITAs	Indian trust assets
ITCA	Inter-Tribal Council of Arizona
LCR MSCP	Lower Colorado River Multi-Species Conservation Plan
LMNRA	Lake Mead National Recreation Area
LTEMP	Long-Term Experimental and Management Plan
m^2	square meter
maf	million acre-feet
M&I	municipal and industrial
Mexico	United Mexican States
mg/L	milligrams per liter

MOA	memorandum of agreement
MOU	memorandum of understanding
Msl	mean sea level
MST	mountain standard time
MT	metric tons
MW	megawatts
MWD	Metropolitan Water District of Southern California
MWh	megawatt hours
NAAQS	National Ambient Air Quality Standards
NDOW	Nevada Department of Wildlife
NEPA	National Environmental Policy Act of 1969
NHPA	National Historic Preservation Act of 1966
NIA	non-Indian agriculture
NIB	Northerly International Boundary
NOI	Notice of Intent
NPS	National Park Service
NRHP	National Register of Historic Places
NWR	National Wildlife Refuge
PA	programmatic agreement
PABCO	Pacific Coast Building Products
P-DP	Parker-Davis Project
PM	particulate matter
PO&M	power operations and maintenance
ppb	parts per billion
PPR	present perfected right
PRPA	Paleontological Resource Protection Act
PSD	Prevention of Significant Deterioration
Reclamation	Bureau of Reclamation
RM	river mile
ROD	Record of Decision
Secretary	Secretary of the Interior
SEIS	supplemental environment impact statement
Service	United States Fish and Wildlife Service
SHPO	State Historic Preservation Office
SIB	Southerly International Boundary
SNWA	Southern Nevada Water Authority
SNWP	Southern Nevada Water Project
SRWYC	Sacramento River Water Year Classification
SSAM	Salton Sea Accounting Model
SUIT	Southern Ute Indian Tribe
TCP	traditional cultural property
TDS	total dissolved solids
THPO	Tribal Historic Preservation Officer

US	United States
USC	United States Code
USGS	United States Geological Survey
USIBWC	United States Section of the International Boundary and Water Commission
WAPA	Western Area Power Administration
WECC	Western Electricity Coordinating Council

Chapter 1. Purpose and Need

1.1 Introduction

The Colorado River Basin (Basin) provides essential water supplies to approximately 40 million people, nearly 5.5 million acres of agricultural lands, hydroelectric renewable power, recreational opportunities, habitat for ecological resources, and other benefits across the western United States and northwestern United Mexican States (Mexico). The Basin occupies an area of approximately 250,000 square miles in the western United States and 3,500 square miles in northwestern Mexico. The Colorado River Compact of 1922 (Compact) divided the Colorado River system into two sub-basins, the Upper Basin and the Lower Basin, and divided the seven states within the Basin into the Upper Division and the Lower Division (**Map 1-1**). Upper Division states include Colorado, New Mexico, Utah, and Wyoming, and the Lower Division includes Arizona, California, and Nevada. Additionally, there are 30 federally recognized Tribes in the Basin (see **Section 4.4** for more information).

The Secretary of the Interior (Secretary) is vested with the responsibility to manage the mainstream waters of the lower Colorado River and operate federal facilities pursuant to applicable federal law. This responsibility is carried out consistent with a body of documents that are commonly referred to as the "Law of the River." While there is no single accepted formal definition of this phrase, the Law of the River comprises numerous operating criteria, regulations, administrative decisions, direction included in federal statutes, interstate compacts, court decisions and decrees, an international treaty with Mexico, and contracts.

The Department of the Interior's (Department) Bureau of Reclamation (Reclamation) is tasked with operating facilities in both the Upper and Lower Basins. Reclamation constructed, owns, and operates facilities on the Colorado River pursuant to numerous congressional authorities. Reclamation operates Glen Canyon Dam and other major dams, along with various irrigation and diversion structures, as part of the Upper Basin Colorado River Storage Project (CRSP). Reclamation operates Hoover Dam and other major facilities in the Lower Basin pursuant to the Boulder Canyon Project Act (BCPA) and other related federal statutes. Reclamation operates these facilities to meet their legally authorized purposes, including long-term water supplies for the Colorado River Basin. Therefore, Reclamation continuously assesses the integrity of these facilities and their operations across a range of operating scenarios. **Appendix A**, Overview of Colorado River Operations, provides additional information about the Law of the River, water apportionment among the Upper and Lower Division States, and river operations.

The Colorado River is approximately 1,450 miles in length, originating along the Continental Divide in Rocky Mountain National Park in Colorado and historically flowing to the Sea of Cortez. Most of the total annual flow in the Basin is runoff from mountain snowmelt. As such, snowpack that accumulates through April provides a reasonable basis for forecasting the majority of the runoff

the total annual flow in the Basin is runoff from mountain snowmelt. As such, snowpack that accumulates through April provides a reasonable basis for forecasting the majority of the runoff through the remainder of the operating year.[1] Major tributaries to the Colorado River include the Green, San Juan, Yampa, Gunnison, and Gila Rivers.

Climate varies significantly throughout the Basin. Most of the Basin is arid or semi-arid, and generally receives less than 10 inches of precipitation per year. In contrast, many of the mountainous areas that rim the northern portion of the Basin receive historical averages exceeding 40 inches of precipitation per year. While the annual flow of the Colorado River and its tributaries varies considerably from year to year, the Basin is currently experiencing a prolonged period of aridification caused by climate change, with extended periods of drought and record low-runoff conditions. The period from 2000 through 2022 is the driest 23-year period in more than a century and one of the driest periods in the last 1,200 years. This has resulted in historically low reservoir levels at Lake Powell and Lake Mead (**Figure 1-1**).

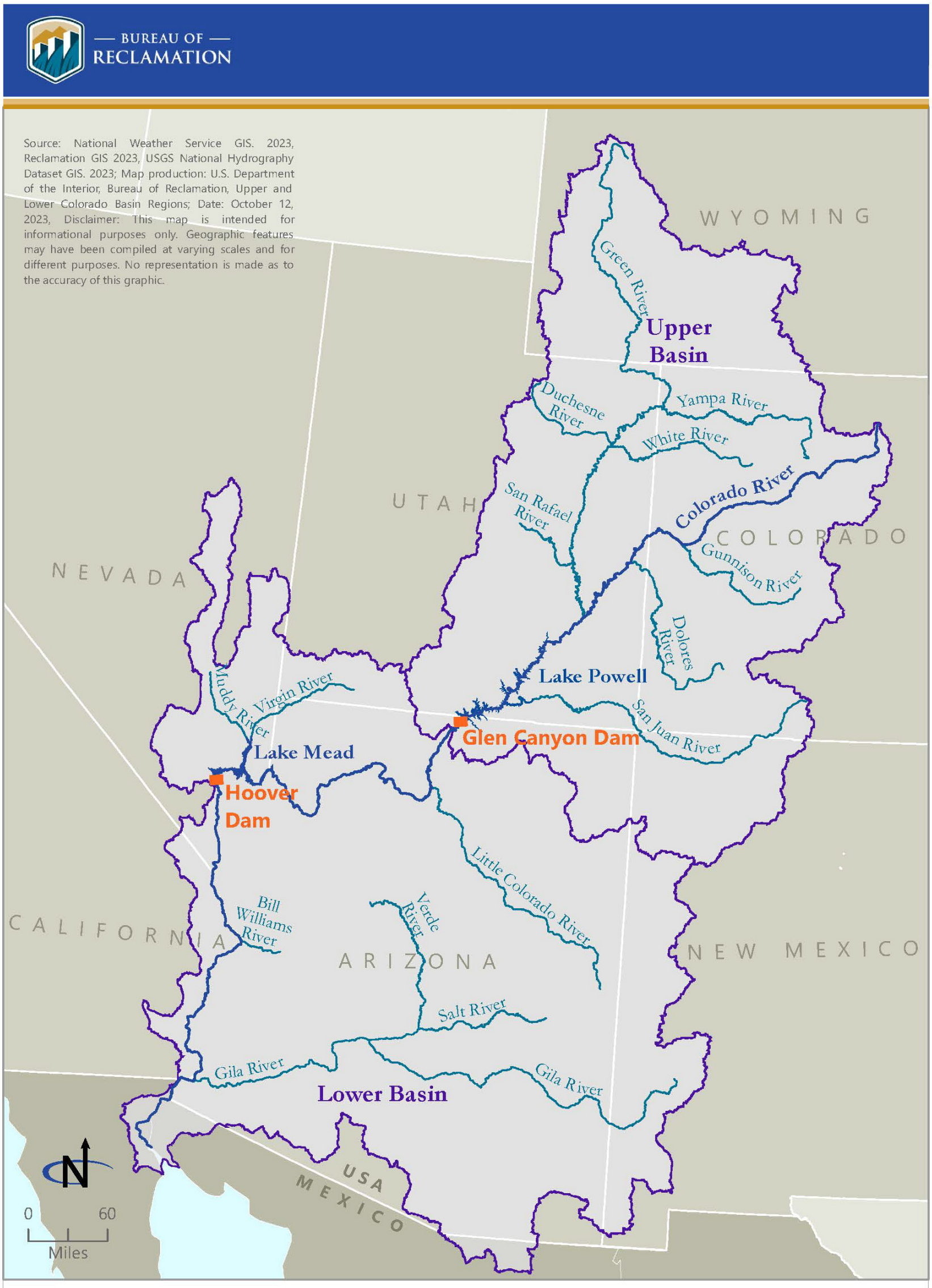
The dry hydrology in recent years has resulted in low elevations at Glen Canyon Dam and Hoover Dam, providing operating experience at these elevations and an opportunity to assess facility performance at low elevations. Reclamation is learning from low-elevation operations and refining the operating parameters for these facilities to incorporate new information and operating experience as it becomes available. Additionally, the likelihood that reservoir elevations could be lower (both in magnitude and duration) in the future because of drier hydrology makes it necessary for Reclamation to plan for operating in these even lower elevations for an extended period of time. As Reclamation evaluates and refines operating parameters it will prioritize safe and reliable operations.

Reclamation, the Department, Colorado River Basin States (Basin States), Mexico, Tribes, and other Basin water users have undertaken a series of intensive efforts to respond to the extended drought and historically low reservoir levels in the Basin. In December 2007, the Department signed the Record of Decision (ROD) for the Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead (2007 Interim Guidelines; DOI 2007). The 2007 Interim Guidelines, which were anticipated to be in place through 2026, provide operating criteria for Lake Powell and Lake Mead, including provisions designed to provide a greater degree of certainty to water users about timing and volumes of potential water delivery reductions, and additional operating flexibility to conserve and store water in the system.

The 2007 Interim Guidelines adopted ranges of releases from Glen Canyon and Hoover Dams that were linked to reservoir elevations in Lake Powell and Lake Mead, respectively. The 2007 Interim Guidelines were adopted for a limited period ("interim") to provide an opportunity for Reclamation and interested entities to gain valuable experience for the management of Lake Powell and Lake Mead under modified operations, with the goal of improving the analytical bases for making future operational decisions, whether during the interim period or after.

[1] The operating year for Glen Canyon Dam runs from October 1 through September 30; the operating year for Hoover Dam runs from January 1 through December 31. Throughout this SEIS, the term "operating year" is used instead of "water year."

Map 1-1
Colorado River Basin and Glen Canyon and Hoover Dams



Map 1-1
Upper and Lower Division States of the Colorado River

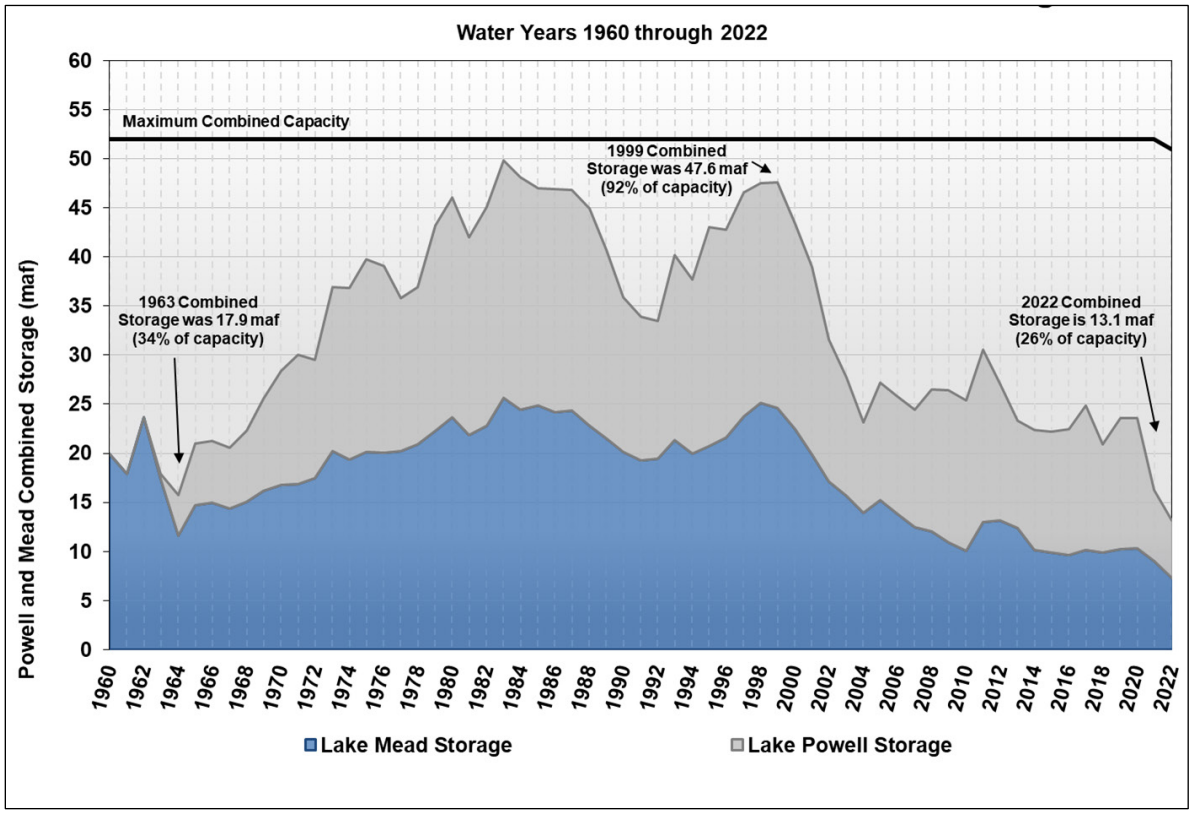
- Colorado River
- Colorado River tributary
- Dam
- Colorado River Basin, Upper and Lower Basins

States in the Colorado River Basin (Wyoming, Colorado, Utah, and New Mexico are Upper Division states, and Arizona, California, and Nevada are Lower Division states)

While portions of northwestern Mexico are part of the Basin, these areas are not within the geographic scope of analysis for this SEIS. This SEIS does not address water deliveries to Mexico.

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Figure 1-1
Lake Powell and Lake Mead End of Water Year Storage



In 2019, a number of DCPs were signed, as directed by Congress in the 2019 Colorado River Drought Contingency Plan Authorization Act (DCPA) (Public Law 116-14), outlining strategies to address the ongoing drought and low-runoff conditions in the Upper and Lower Basins.[3] The DCPs addressed operations in both the Upper and Lower Basins.[4] The Upper Basin DCP is designed to reduce the risk of reaching critical elevations at Lake Powell, help assure continued compliance with the Compact, and facilitate and encourage storage of conserved water in the Upper Basin that could help establish the foundation for a demand management program that may be developed in the future. The Lower Basin DCP is designed to require additional contributions of water to Lake Mead storage at predetermined elevations and create new flexibility to incentivize additional voluntary conservation of water to be stored in Lake Mead. Additional information on the operating criteria, regulations, administrative decisions, and statutes affecting Colorado River operations are included in **Appendix A** of this Supplemental Environmental Impact Statement (SEIS) and in Section 5.1 of the 2007 Interim Guidelines Final EIS (2007 FEIS; Reclamation 2007).

[3] More information at: https://www.usbr.gov/dcp/

[4] In particular, given the focus on Glen Canyon Dam operations since 2021, the DCP addressing Upper Basin operations that has been the key operational document is the Drought Response Operations Agreement (DROA). The DROA identifies a process to temporarily move water stored in the CRSP Initial Units above Lake Powell—Blue Mesa (a component of the Aspinall Unit), Flaming Gorge, and Navajo—to Lake Powell when it is projected to approach or decline below elevation 3,525 feet. See more information at: https://www.usbr.gov/dcp/droa.html.

The Department has taken multiple steps to respond to historic drought and low-runoff conditions in the Basin since 2007, including several unprecedented and emergency actions since 2021:

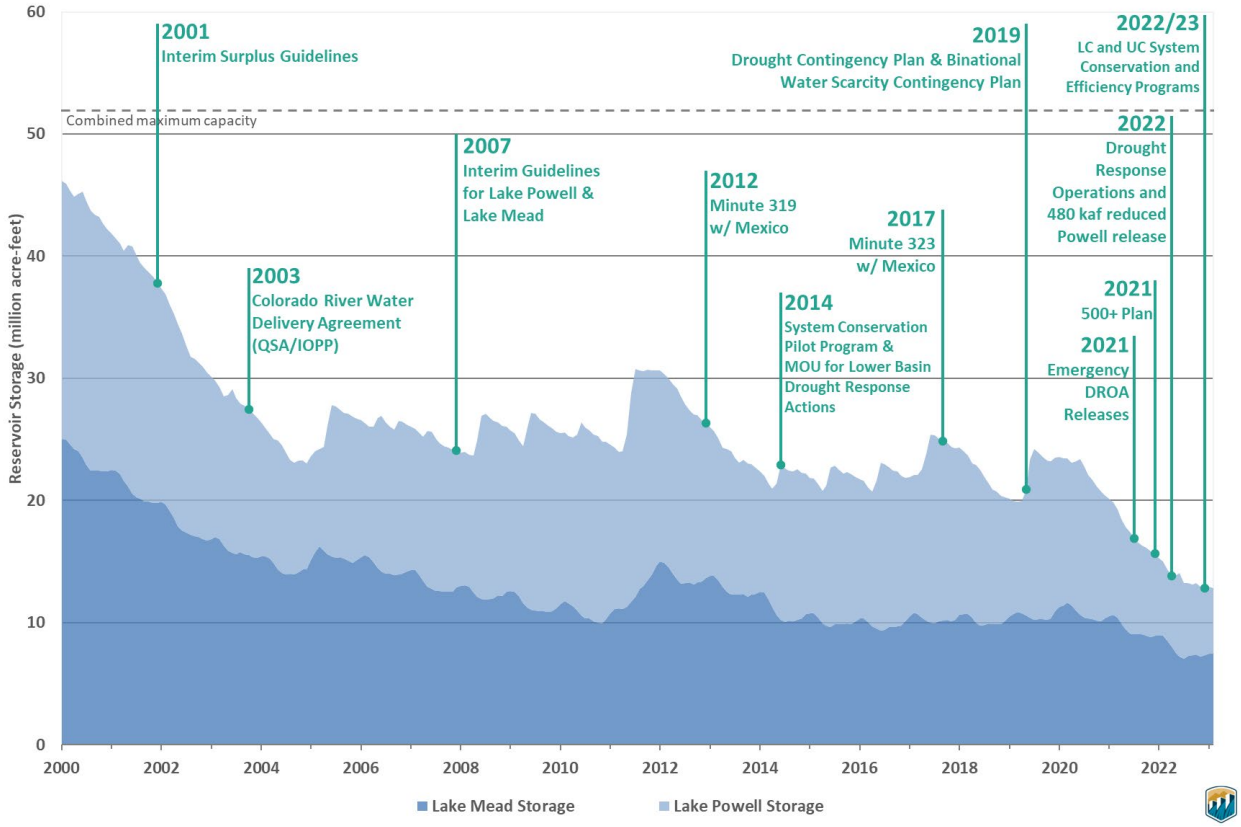
- **2014 – System Conservation Programs:** A 2014 agreement among Reclamation and the major municipal water providers (Denver Water, Central Arizona Water Conservation District [CAWCD], Metropolitan Water District of Southern California [MWD], and Southern Nevada Water Authority [SNWA]) in both the Upper and Lower Basin established a pilot program to fund the creation of Colorado River system water through voluntary, measurable reductions in consumptive use for the benefit of all users to help offset declining reservoir elevations.
- **2019 – Drought Contingency Plans:** As described above, the DCPs provide a framework for additional actions to help the Basin adapt to drought.
- **2021 – Emergency Drought Response Operations Agreement (DROA) Releases:** Consistent with DROA provisions to protect Lake Powell's target elevation, Reclamation increased releases from the upstream initial units of the CRSP to deliver an additional 181,000 acre-feet (af) of water to Lake Powell by the end of December 2021.
- **2021 – 500 Plus Plan:** Recognizing the history of low-runoff conditions and the variability of flows in the Basin, workgroups concluded an additional 500,000 af or more per year of additional reductions in water use were required. The plan was to conserve additional water above what is required under a Lower Basin shortage condition and contributions under the Lower Basin DCP. The 500 Plus Plan's parties identified and are funding projects in each of the three Lower Division States. The projects include Tribal, agricultural, and municipal water users.
- **2022 – Drought Response Operations and 480,000-af Reduced Lake Powell Release:** On May 3, 2022, Reclamation announced two separate drought response actions to help increase Lake Powell storage by nearly 1.0 million acre-feet (maf) from May 2022 through April 2023. These actions were (1) releasing approximately 500,000 af of water from Flaming Gorge Reservoir under the DROA and (2) holding 480,000 af in Lake Powell by reducing Glen Canyon Dam's annual release volume from 7.48 maf to 7.00 maf.[5] [6]
- **2022/2023 – Lower Colorado and Upper Colorado System Conservation and Efficiency Programs:** The programs were created to address the unprecedented drought in the Basin and are part of the commitment made by the Department on August 16, 2022, to address the drought crisis with prompt and responsive actions and investments to create programs and improve water management efforts across the Basin.

[5] Letter from Tanya Trujillo, Assistant Secretary for Water and Science, Department, to Thomas Buschatzke, Governor's Representative, State of Arizona, May 3, 2022. https://www.usbr.gov/uc/DocLibrary/Plans/20220503-2022DROA-GlenCanyonDamOperationsDecisionLetter-508-DOI.pdf https://www.usbr.gov/uc/DocLibrary/Plans/20220503-2022DROA-GlenCanyonDamOperationsDecisionLetter-508-DOI.pdf

[6] As of December 31, 2023, all previous DROA releases from Blue Mesa Reservoir have been recovered and approximately 95,000 af of previous DROA releases from Flaming Gorge Reservoir remain to be recovered. Full recovery at Flaming Gorge is projected by the end of February 2024.

Figure 1-2 shows how reservoir elevations have declined despite these efforts.[7]

Figure 1-2
Actions and Agreements to Protect Lake Powell and Lake Mead Reservoir Elevations (since 2000)



While these actions, especially the DCPs, were intended to preserve Reclamation's ability to undertake post-2026 operational planning with a stable system and avoid crisis planning, Colorado River water supplies continue to decline, resulting in historically low reservoir levels at Lake Powell and Lake Mead. Following adoption of the DCPs in 2019, the Basin experienced three of the lowest consecutive years of inflow on record from 2020 through 2022, with 2021 among one of the lowest inflow years on record. During this time, the combined storage of Lake Powell and Lake Mead declined from about 50 percent to 25 percent of total live capacity. Absent a meaningful and unexpected change in hydrologic conditions and trends, water use patterns, or both, Colorado River reservoirs will continue to decline to critically low elevations, threatening essential water supplies across seven states in the United States and two states in Mexico. Although hydrology improved in 2023, it is foreseeable that without appropriate responsive actions and under a continuation of poor

[7] This SEIS does not affect the provisions of the 1944 Water Treaty and the implementing minutes; this is because the SEIS is not considering alternative actions that would change water deliveries to Mexico.

hydrologic trends, major Colorado River reservoirs could continue to decline to "dead pool" in the coming years.[8]

Given the declining reservoir elevations, the anticipated continuing trend of low-runoff conditions, and the need to protect infrastructure and Colorado River operations, the Department published a Notice of Intent (NOI) in the *Federal Register* on November 17, 2022. The NOI provided the public with the Department's intent to "promptly identify and analyze modified operating guidelines to address current and foreseeable hydrologic conditions" (87 *Federal Register* 69042, 69043 (November 17, 2022)). Under the 2007 Interim Guidelines, 2019 DCPs, and related agreements, Reclamation currently lacks the operational tools necessary to address projected extreme drought conditions and is prioritizing implementation of near-term actions to stabilize the decline in reservoir storage and prevent system collapse. The modification of operating guidelines noted in the *Federal Register* notice is focused on the 2023–2026 period (i.e., the remainder of the interim period). Any actions adopted pursuant to this SEIS process would be separately developed from operational planning for the period beyond 2026; however, these tools may inform such later planning.

1.2 Proposed Federal Action

Recognizing the risks facing the Basin, the Department concluded in 2022 that immediate development of additional operational tools for Lake Powell and Lake Mead was necessary to ensure continued operations that are prudent or necessary for safety of dams, public health and safety, and other emergency situations.

Accordingly, Reclamation is proposing to revise the 2007 Interim Guidelines for the near-term operation of Glen Canyon and Hoover Dams to address the potential for continued low-runoff conditions in the Basin.[9] Reclamation has concluded that the potential impacts of low-runoff conditions pose unacceptable risks to routine operations of Glen Canyon and Hoover Dams during the remainder of the interim period (prior to January 1, 2027) and that modified operating guidelines need to be expeditiously developed.

As described in the Dear Reader Letter to the revised Draft SEIS, hydrology in the Colorado River Basin has improved compared with the hydrology at the time the SEIS analysis began. The updated hydrologic modeling from June 2023 shows a much lower risk of reaching critical elevations at Lake Powell and Lake Mead through 2026 than prior hydrologic modeling from September 2022. However, the risk of reaching critical elevations remains, as does the need to develop tools to address the risk of reaching critical elevations. This SEIS analyzes those tools, making appropriate adjustments based on improved hydrology, as described in the **Dear Reader Letter**.

[8] Dead pool refers to elevations at which water cannot be regularly released from a reservoir, which would effectively preclude Colorado River diversions to downstream users.
[9] The 2024 operating year for Glen Canyon Dam begins October 1, 2023; the 2024 operating year for Hoover Dam begins January 1, 2024.

Given the potential risks to infrastructure[10] and public health and safety, the Department will promptly identify and analyze modified operating guidelines through this SEIS to address current and foreseeable hydrologic conditions. The Proposed Action would modify and/or add to the following sections of the 2007 Interim Guidelines Record of Decision (2007 ROD) published at 73 *Federal Register* 19881 (April 11, 2008):

- Section 2. Determination of Lake Mead Operation During the Interim Period
- Section 6. Coordinated Operation of Lake Powell and Lake Mead During the Interim Period
- Section 7. Implementation of Guidelines

Reclamation has already begun efforts that will lead to preparation of an additional Environmental Impact Statement (EIS) for operating guidelines after 2026. See 87 *Federal Register* 37884 (June 24, 2022) and 88 *Federal Register* 39455 (June 16, 2023).

This document, prepared in accordance with the National Environmental Policy Act of 1969 (NEPA), analyzes potential modifications to existing reservoir operations. As these analyses are developed, it is important to note that reservoir operation is an inherently ongoing process that must continue while a new operation is being analyzed and determined. As water flows into a reservoir, inflows stored above the dam must be managed in light of the specific physical and operational characteristics of the dam and reservoir. These can include storage capacity, types and elevations of structures to release water, or the need to preserve space for additional inflow as snow melts. As stored water is released from the reservoir, it must be released consistent with the specific physical and operational characteristics of the release structures and the river below, which can include maximum and minimum flow rates; safety restrictions to protect downstream facilities or water uses; considerations to meet ecological conditions, such as the time of year or temperature when water is released; or physical limits where water can no longer be released.

Reservoir operators must routinely—and continuously—adjust releases for these characteristics; there is no option for reservoir operations to simply stop while new rules are developed. Operators must continuously adjust to changing hydrologic conditions—both high-water events, such as being prepared for unexpected snowmelt, and low-water events, such as elevations that approach dead pool—regardless of the timelines or process to determine new reservoir operating rules. These adjustments are further complicated with the coordinated operation of the largest reservoirs in the

[10] A primary concern for the Department has been to identify and implement actions to ensure Glen Canyon Dam continues to provide downstream water releases as designed and intended (i.e., it remains above elevations at/about 3,490 feet above mean sea level). While additional analysis may find that water can be released through the hydropower units when Lake Powell is at slightly lower levels, at this time, 3,490 feet is the cutoff for routine operations. Below this elevation, all water could only be released through Glen Canyon Dam's four river outlet works (reducing operational redundancy and, thus, increasing the operational risk for downstream releases). This would create a risk of water supply interruptions to water users that rely on Lake Powell for water supply, hydropower interruptions to users that rely on Glen Canyon Dam for power supplies, and increased uncertainty regarding downstream releases should Lake Powell continue to decline. As discussed herein, if strategies are adopted to reduce Glen Canyon Dam releases to protect the reliability of routine operations, Lake Mead's water levels will decline at an accelerated rate, increasing the risk of Lake Mead declining to critically low levels and threatening water deliveries to those that rely on Lake Mead for water supplies.

Basin (Lake Powell and Lake Mead) and the other system reservoirs (both upstream of Lake Powell and downstream of Lake Mead).

In operating these major facilities, the Department must consider the overall conditions in the Basin in order to make the most prudent operational decisions. The overall sound and prudent operation of the major reservoirs on the Colorado River system during a period of declining inflows and historically low reservoirs will almost certainly lead to objection by specific entities to the impacts of one or more aspects of water management decisions. The Department will follow applicable federal law and prudent reservoir operations with respect to any modified operating guidelines, recognizing that with current reservoir elevations at historic lows, even one additional low-runoff winter season could have unprecedented adverse consequences across the Basin.

1.3 Purpose of and Need for Action

The purpose of the SEIS is to supplement the 2007 Interim Guidelines to modify guidelines for operation of the Glen Canyon and Hoover Dams to address historic drought, historically low reservoirs, and low-runoff conditions in the Basin. The need for the modified operating guidelines is based on the potential that continued low-runoff conditions in the Basin could lead Lake Powell and Lake Mead to decline to critically low elevations, impacting operations through the remainder of the interim period (prior to January 1, 2027).

To ensure Glen Canyon Dam continues to operate under its intended design for purposes of maintaining downstream water releases and protecting infrastructure from the potential consequences of operating at or below critical elevations, Reclamation may need to modify current operations and reduce Glen Canyon Dam downstream releases, impacting downstream resources and reservoir elevations at Lake Mead. Consequently, to protect Hoover Dam operations, system integrity, and public health and safety, Reclamation also may need to modify current operations and reduce Hoover Dam downstream releases.

Such modified Hoover Dam operations would, among other issues, address Section 7.B.4 of the 2007 Interim Guidelines as well as the commitments set forth in Section V.B.2 of Exhibit 1 to the 2019 DCPs. Both the 2007 Interim Guidelines and the 2019 DCPs contemplate the need for additional measures to protect Lake Mead elevations, with the DCPs adding the commitment of participating Lower Basin DCP parties to take "individual and collective action in the Lower Basin to avoid and protect against the potential for the elevation of Lake Mead to decline to elevations below 1,020 feet." As noted above, Section 7.D of the 2007 Interim Guidelines contemplates that modified operating provisions may be required if "extraordinary circumstances arise. Such circumstances could include operations that are prudent or necessary for safety of dams, public health and safety, other emergency situations, or other unanticipated or unforeseen activities arising from actual operating experience." The Department finds that such circumstances exist currently.

1.4 Lead and Cooperating Agencies

The Secretary is responsible for the operation of Glen Canyon Dam and Hoover Dam pursuant to applicable federal law. The Secretary is also vested with the responsibility of managing the mainstream waters of the lower Colorado River pursuant to federal law. This responsibility is carried out consistent with the Law of the River. Reclamation, as the agency designated to act on the Secretary's behalf with respect to these matters, is the lead federal agency for the development of this SEIS in accordance with NEPA.

Five federal agencies are cooperating for purposes of assisting with environmental analysis and preparation of this SEIS. These cooperating agencies are the Bureau of Indian Affairs (BIA), the United States Fish and Wildlife Service (Service), the NPS, Western Area Power Administration (WAPA), and the United States Section of the International Boundary and Water Commission (USIBWC).

The BIA has responsibility for the administration and management of lands held in trust by the United States for American Indians (Indian) and Indian Tribes located within the Basin. Developing forestlands, leasing assets on these lands, directing agricultural programs, protecting water and land rights, and developing and maintaining infrastructure and economic development are all part of the BIA's responsibility.

The Service is involved in the conservation, protection, and enhancement of fish, wildlife, and plants and their habitats for the continuing benefit of the American people. The Service manages numerous facilities related to the Colorado River, including four national wildlife refuges along the lower Colorado River. Among its many other key functions, the Service administers and implements federal wildlife laws, protects endangered species, manages migratory birds, restores nationally significant fisheries, conserves and restores wildlife habitat such as wetlands, and assists foreign governments with international conservation efforts. It also oversees the federal aid program that distributes hundreds of millions of dollars in excise taxes on fishing and hunting equipment to state fish and wildlife agencies.

The NPS administers areas of national significance along the Colorado River, including Glen Canyon National Recreation Area (GCNRA), Grand Canyon National Park (GCNP), and Lake Mead National Recreation Area (LMNRA). The NPS is primarily responsible for conservation of natural and cultural resources and visitor experience (including recreation) in these areas from offices located at Page, Arizona; Grand Canyon, Arizona; and Boulder City, Nevada, respectively. The NPS also grants and administers concessions for the operation of marinas and other recreation facilities at Lake Powell and Lake Mead, as well as concessions' operations along the Colorado River between Glen Canyon Dam and Lake Mead.

WAPA markets and distributes hydroelectric power and related services within a 15-state region of the central and western United States, and it is one of four power marketing administrations within the Department of Energy. Its role is to market and transmit electricity from multi-use water projects. WAPA markets and transmits power generated from the various hydropower plants within the Basin and operated by Reclamation. WAPA customers include municipalities, cooperatives,

public utility and irrigation districts, federal and state agencies, investor-owned utilities (only one of which purchases firm power from WAPA), and Indian Tribes throughout the Basin. Wholesale customers, in turn, provide retail electric service to millions of consumers within the seven Basin States.

IBWC (2017) is a binational organization responsible for administration of the provisions of the February 3, 1944, United States-Mexico Treaty on Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande (1944 Water Treaty), which allots Colorado River waters to Mexico. IBWC responsibilities under the 1944 Water Treaty and other international agreements include assuring delivery of Mexico's Colorado River water allotment, protecting lands along the Colorado River from floods by levee and floodway construction projects, addressing border sanitation and other water quality problems, and preserving the Colorado River as the international boundary. The USIBWC and the Mexican Section have their headquarters in the adjacent cities of El Paso, Texas, and Ciudad Juarez, Chihuahua, respectively.

1.5 Scope of the SEIS

As a supplement, this SEIS incorporates by reference the original 2007 FEIS. The SEIS focuses on new information, changes in conditions since 2007, and impacts associated with the considered alternatives. The SEIS does not analyze the operations of the entire Colorado River system; rather, it focuses on only addressing the low-runoff and low-level conditions at Glen Canyon and Hoover Dams. Reclamation does not control the hydrology that affects inflows to Lake Powell. The best available scientific information indicates that low-runoff conditions may persist and worsen with warming conditions in the Basin.

While the potential for the current and persistent low-level conditions was recognized as a low possibility to occur during the interim period as part of the analysis supporting the development of the 2007 FEIS, the 2007 Interim Guidelines, as adopted, did not include provisions that would prevent system collapse under these persistent low-level conditions. Numerous initiatives since 2007 (for example, Minute 323 and the 2019 DCPs) have led to more robust policies; however, notwithstanding these efforts, Reclamation lacks the operating tools to sufficiently protect system operations. Therefore, in this SEIS, Reclamation is considering operations that are specifically designed to manage the respective reservoirs at lower elevations to more reliably maintain congressionally authorized infrastructure, operations, water deliveries, and power generation, and to avoid dead pool conditions, as feasible.

The hydrologic modeling performed for this SEIS examines scenarios based on flows in the Basin over the past 30 years, which includes 23 years of drought conditions. To examine even more severe drought conditions, the hydrologic modeling examines Basin flow scenarios with 90 percent and 80 percent of the flows seen over the past 30 years (up to a 20 percent reduction in flows compared with the last 30 years). The SEIS analyzes alternative operational scenarios to react to potential low-level conditions; it does not assess current or future river flow forecasts or attempt to predict actual operations. The SEIS does not include any changes to other operational agreements, such as LTEMP, DCPs, DROA, or Minute 323; operational planning and implementation would implement these agreements per their own terms, unless otherwise stated in this SEIS.

As noted above, on November 17, 2022, Reclamation published a NOI about the preparation of the SEIS (*Federal Register* Vol. 87, No. 221, 69042–69045). It also initiated a public scoping process requesting comments concerning the scope of the analysis, potential alternatives, and identification of relevant information and studies. Reclamation conducted web-based public scoping webinars on November 29 and December 2, 2022, soliciting public comments from interested parties by December 20, 2022. Reclamation also coordinated with representatives from the Basin States, Basin Tribes, and Mexico (through the USIBWC). All public comment letters, along with a scoping summary report (Reclamation 2023a), are available on the project website.[11]

Several reservoir and water management decisional documents and agreements that govern the operations of Lake Powell and Lake Mead expire at the end of 2026, including the 2007 Interim Guidelines, the 2019 DCPs, and international agreements between the United States and Mexico pursuant to Minute 323 to the 1944 Water Treaty. Concurrent to this SEIS process, Reclamation is beginning to develop successor domestic agreements for the continued operation of Lake Powell and Lake Mead ("post-2026 operations"). Such post-2026 operations will be analyzed in a separate EIS. See 87 *Federal Register* 37884 (June 24, 2022) and 88 *Federal Register* 39455 (June 16, 2023).

1.5.1 Affected Region and Interests

The geographic region that would be affected by the proposed alternatives begins with Lake Powell and extends downstream along the Colorado River floodplain to the Southerly International Boundary (SIB) with Mexico. The proposed alternatives would also potentially affect interests of organizations and individuals whose geographic distribution extends beyond the Colorado River floodplain into the service areas of certain water agencies in the Lower Division States.

1.5.2 Relevant Issues

As a result of the scoping process, Reclamation considered issues that may be relevant to the EIS analysis. **Table 1-1** lists the resources and issues potentially significantly affected and addressed in this SEIS. It also lists those that were not considered potentially significant, which are not analyzed in this SEIS. The primary impact drivers are lower flows, changing reservoir levels, and changes in releases and deliveries.

[11] Project website: https://www.usbr.gov/ColoradoRiverBasin/SEIS.html

Table 1-1
Resources Considered for Detailed Analysis

Resource	Potentially Significant	Issue Areas
Water Resources		
Hydrologic Resources	Yes	Reservoir elevations, reservoir releases, river flows, groundwater
Water Deliveries	Yes	Apportionments, supply determinations, total water deliveries, shortages, public health and safety
Water Quality	Yes	Salinity, sediment, temperature, dissolved oxygen (DO), metals, nutrients/algae, and perchlorate
Physical Resources		
Air Quality	Yes	Fugitive dust and exposure of lake shoreline, greenhouse gas (GHG) emissions from alternative power sources
Visual	Yes	Attraction features, calcium carbonate ring in reservoirs, sediment deltas, Colorado River landscape character between Glen Canyon Dam and Lake Mead, broader landscape character in Lower Division States
Cultural Resources	Yes	Exposure and damage to resources (historic properties) as lake levels recede and river levels drop; disturbance to biological resources, which are contributing elements to Traditional Cultural Properties (TCPs)
Paleontology	Yes	Exposure and damage to resources as lake levels recede
Geology and Soils	No	No potential for effect; sedimentation is addressed in water quality
Minerals	No	No potential for effect
Noise	No	No potential for effect
Biological Resources		
Vegetation	Yes	Riparian and wetland habitat, weeds
Wildlife	Yes	Amphibians, fish, reptiles, raptors, mammals, waterfowl
Special Status Species	Yes	Threatened and endangered species, state and Tribal sensitive species
Human Environment		
Recreation	Yes	Shoreline public use facilities, reservoir boating, whitewater boating, and fishing
Energy and Hydropower	Yes	Economic analysis and capacity
Economic Impacts	Yes	Regional agricultural economic contributions, economic contributions from recreation activities, economic impacts from municipal and industrial (M&I) water availability
Environmental Justice	Yes	Disproportionate effects on minority and low-income populations
Indian Trust Assets (ITAs)	Yes	Water rights and trust lands

1.6 Changes to the Final SEIS

In response to public, Tribal, and agency comments on the revised Draft SEIS, several additions were made to the chapters and appendixes in the Final SEIS. No changes to the Proposed Action or alternatives were required because of comments. The responses to comments in the Response to Public Comments report (**Appendix H**) note when and where text has been changed in the SEIS based on a specific comment. A summary of changes is as follows:

- Updated water quality figures to represent current modeling results and analysis
- Added acreage of marsh and cottonwood-willow vegetation in the Hoover Dam to SIB reach that could be affected under the Proposed Action
- Added a table to summarize land cover types from Lake Mead to the SIB
- Added two tables to demonstrate the predicted changes in native and nonnative species under the no action alternative
- Updated water quality affected environment to more explicitly acknowledge that salinity control efforts also occur on federal lands
- Updated water quality figures (Exceedance Probability for Temperature and Salinity Concentrations in Glen Canyon Dam Releases, Predicted Release Salinity Concentration [mg/L] from Glen Canyon Dam over the 5-Year Simulation Period, Projected Release Temperatures from Glen Canyon Dam over the 5-Year Simulation Period for Each Selected Trace and Management Scenario, Box Plots Showing the Number of Days with an Average Glen Canyon Dam Release Temperature over 16°C [60.8°F] for All CRMMS Traces and Each Alternative for Operating Years 2023-2026, and Box Plots Showing the Number of Days with an Average Glen Canyon Dam Release Temperature over 20°C [68°F] for All CRMMS Traces and Each Alternative for Operating Years 2023-2026) to accurately represent modeling results and analysis
- Updated water quality sediment cumulative effects section to include the proposed flow options for the LTEMP SEIS
- Updated discussion of LTEMP minimum releases related to whitewater boating
- Updated the documentation of public involvement and Tribal coordination efforts

Hydrology and Operations

Between the revised draft and final documents, Reclamation reviewed the current hydrology to determine if it warranted changes to the analysis. Based on this review, Reclamation determined that the hydrology used in the revised Draft SEIS analyzed a range of hydrology for June 2023 – September 2024 even drier than the current forecast. Additionally, since the analyses are not intended to suggest actual probabilities but rather compare performance across alternatives, and because it is intended to analyze operational strategies across a wide range of low-flow hydrologic scenarios, the hydrology used in the revised Draft SEIS is sufficient and did not warrant any revisions.

The dry hydrology in recent years has resulted in low elevations at Glen Canyon Dam, providing operating experience at these elevations and an opportunity to assess facility performance at low elevations (e.g., 3,500 feet at Lake Powell, which is approaching the elevation of the top of the penstocks at Glen Canyon Dam at 3,490 feet). Reclamation is learning from low-elevation operations over the past few years and is refining and will continue to refine the operating parameters for these facilities to incorporate new information and operating experience as it becomes available. Since the publication of the revised Draft SEIS, Reclamation has obtained additional information about enhanced risks of relying on the river outlet works, particularly as the exclusive means of releasing water at low elevations for sustained periods of time at Glen Canyon Dam.[12] Reclamation will continue to evaluate these risks and any appropriate mitigation measures and will manage Glen Canyon Dam operations accordingly.

The hydrological modeling and analysis in the revised Draft EIS show that the probability of Lake Powell declining below 3,500 feet under the Proposed Action is very low. Specifically, of the 90 modeled traces, which include 20-percent reductions to an already dry period of hydrology, one modeled trace in water year 2025 and eight modeled traces in water year 2026 show Lake Powell elevations below 3,500 feet. In some of these modeled traces, Lake Powell's elevation drops below 3,500 feet for a few months before recovering back above 3,500 feet.

1.7 Summary of the Contents of this SEIS

This SEIS describes the alternatives considered, the analysis of the potential effects of these alternatives on modified Colorado River operations and associated resources, and environmental commitments associated with the alternatives. The contents of the chapters in this volume are as follows:

- **Chapter 1, Purpose and Need,** includes background information leading to this SEIS, identification of the purpose of and need for the near-term reservoir management strategies of Lake Powell and Lake Mead being considered in the proposed alternatives, and the scope of this SEIS.
- **Chapter 2, Description of Alternatives,** describes the process of formulating alternatives and presents a range of reservoir operation strategies and guidelines considered under each alternative, as well as alternatives considered but eliminated from detailed analysis.
- **Chapter 3, Affected Environment and Environmental Consequences,** describes the affected environment for the proposed alternatives and presents evaluations of potential impacts that could result from implementation of the alternatives under consideration. The discussion also addresses environmental consequences (i.e., potential effects of the action alternatives that could occur compared with the No Action Alternative). A methodology, summary, and discussion of cumulative impacts is also included under each resource topic.

[12] With respect to the duration of sustained periods of time, Reclamation studies are underway to determine what duration, if any, of operations that rely solely on use of the river outlet works is appropriate.

- **Chapter 4, Consultation and Coordination,** describes the public involvement process, including public notices, scoping meetings, and hearings. This chapter also describes the coordination with federal and state agencies, Indian Tribes, and Mexico (through the USIBWC) during the preparation of this document and any permitting or approvals that may be necessary for implementation of the proposed alternatives.

In addition to the above, this document includes a list of acronyms used throughout this SEIS; a glossary of commonly used terms; a list of references cited in the SEIS; a list of persons contributing to the preparation of the SEIS; and an index. This document also contains appendixes that consist of documents and other supporting material that provide detailed historical background and technical information concerning the proposed alternatives.

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Chapter 2. Description of the Alternatives

2.1 Development of the Alternatives

This chapter discusses the process used to define, develop, and analyze the range of reasonable alternatives for implementing the proposed federal action. As discussed in **Chapter 1**, Purpose and Need, and in the NOI to prepare this SEIS (87 *Federal Register* 69042, November 17, 2022), Reclamation is proposing modifications and/or additions to the following sections of the 2007 ROD published at 73 *Federal Register* 19881 (April 11, 2008), which were analyzed in the 2007 FEIS:

- **Section 2. Determination of Lake Mead Operation During the Interim Period.** Reclamation is analyzing a revision of Section 2.D, Shortage Conditions, to decrease the quantity of water that would be apportioned for consumptive use in the Lower Division States in years of low flow and low reservoir elevations.
- **Section 6. Coordinated Operation of Lake Powell and Lake Mead During the Interim Period.** Reclamation is analyzing a revision of Sections 6.C, Mid-Elevation Release Tier, and 6.D, Lower Elevation Balancing Tier, to reduce the quantity of water released from Glen Canyon Dam in years of low flow and low reservoir elevations.
- **Section 7. Implementation of Guidelines.** Reclamation is analyzing a revision of Section 7.C, Mid-Year Review, to allow for potential determinations in a mid-year review that would allow for reduced deliveries from Lake Mead, pursuant to Section 2 of the 2007 Interim Guidelines.

The descriptions of the No Action Alternative and Proposed Action, below, discuss how each alternative would modify these sections. The Proposed Action provides operations that are specifically designed to manage the respective reservoirs at lower elevations or prevent reservoir levels from declining in order to more reliably maintain congressionally authorized infrastructure, operations, water deliveries, and power generation, and to avoid dead pool conditions, as feasible.

The range of alternatives considered reflects input from Reclamation, Tribes, the cooperating agencies, stakeholders, and other interested parties, including comments submitted during the SEIS public scoping period and the public comment period on the original Draft SEIS. As described in the **Dear Reader Letter** introducing this revised Draft SEIS, Action Alternatives 1 and 2, which were considered in the original Draft SEIS, have been eliminated from detailed analysis (see **Section 2.8.10** and **Appendix B**, Hydrology Analysis for the No Action Alternative, Action Alternatives 1 and 2, and the Proposed Action).

Among the input Reclamation received were written proposals for alternatives, or components thereof, that met the proposed federal action's purpose and need. For example, in January 2023, Reclamation received a proposal from six Basin States (Arizona, Colorado, Nevada, New Mexico, Utah, and Wyoming) and a proposal from California. Reclamation carefully reviewed these

proposals, along with others received. Several of these proposals were analyzed in the original Draft SEIS in Appendix B in terms of their hydrologic performance over the remainder of the interim period. These proposals were similar to the actions considered in Action Alternatives 1 and 2 in the original Draft SEIS and are similarly affected by the improved June 2023 hydrology. Reclamation is not remodeling these proposals or comparing them against the Proposed Action for the same reasons that Action Alternatives 1 and 2 have been eliminated (see the **Dear Reader Letter** and **Section 2.8.10**).

2.2 Preferred Alternative

Under NEPA, the "preferred alternative" is a preliminary indication of the lead agency's preference of action among the proposed action and alternatives. In accordance with the NEPA implementing regulations (40 CFR 1502.14[d] and 43 CFR 46.425(a)), Reclamation has identified the Proposed Action as the preferred alternative. The Proposed Action provides modified operational guidelines to protect the infrastructure at Glen Canyon and Hoover Dams, while increasing certainty in operations, system integrity, and public health and safety, as required by the Purpose and Need (**Section 1.3**). While Reclamation has identified a preferred alternative in this Final SEIS, actual selection of an alternative for implementation will not occur until the ROD. The decision on the alternative to implement will consider public comments and the full analysis presented in **Chapter 3**.

2.3 Environmentally Preferable Alternative

In accordance with CEQ NEPA regulations (40 CFR 1502.2(b)), Reclamation will identify the environmentally preferable alternative in the ROD for this SEIS.

2.4 Implementation

The Department anticipates adopting additional or modified guidelines for the remaining operating years in the interim period.[1] The Proposed Action provides operational tools for continued low-flow conditions to provide additional protection against reservoirs declining to critically low elevations.

2.5 Common to All Alternatives

Under all alternatives, operations would continue pursuant to the continued implementation of existing agreements that control operations of Glen Canyon and Hoover Dams. Regarding coordinated reservoir operations, the tiers for determining the annual Lake Powell release, based on the volume of water in storage or the corresponding elevations of Lake Powell and Lake Mead, would be the same as described in the 2007 Interim Guidelines for all alternatives. For all alternatives, when Lake Powell's elevation is projected to be above 3,575 feet, Lake Powell would

[1] Glen Canyon Dam and the other Upper Basin reservoir operations for the 2024 operating year begin October 1, 2023; Hoover Dam operations for 2024 begin January 1, 2024. Consistent with the 2007 Interim Guidelines, the DCPs, and Minute 323, these operating determinations will be based on projected January 1, 2024, reservoir conditions at Lake Powell and Lake Mead based on the August 2023 24-Month Study.

continue to operate in the Upper Elevation Balancing Tier or Equalization Tier, as described in the 2007 Interim Guidelines. Operations regarding the creation and use of intentionally created surplus (ICS) would be the same as described in the 2007 Interim Guidelines for all alternatives. For all alternatives, Section III.B. of Exhibit 1 (Lower Basin Drought Contingency Operations) to the Lower Basin Drought Contingency Plan Agreement, as executed pursuant to Public Law 116-14 (2019), provides that DCP contributions are made based on the projected elevation of Lake Mead on January 1, using Reclamation's August 24-Month Study. DCP contributions will continue to be determined based on the elevation of Lake Mead as projected in the 24-Month Study and are in addition to the shortage volumes described in Section 2.D of the 2007 Interim Guidelines.

As noted in **Chapter 1**, there has been extensive focus on the goal of operating Glen Canyon Dam as intended for long-term operations (that is, to keep Lake Powell at or above an elevation of 3,490 feet). However, it is possible that Lake Powell may decline below this critical elevation during the 2025–2026 period. In such an event, at any given time, Glen Canyon Dam would be operated with all available river outlet works. For the purpose of analyzing impacts in this SEIS, Reclamation anticipates having three of the four river outlet works available, due to the need for periodic inspections and routine maintenance. Operations may vary from this assumption to address operating considerations at Glen Canyon Dam based on the actual operating experience at lower elevations.

Reclamation notes that intensive efforts are underway to facilitate water conservation actions in the Basin under a number of programs, including the recent congressional prioritization of funding through 2026 of 4 billion dollars for drought mitigation in western states, with priority given to the Basin and other basins experiencing comparable levels of long-term drought (Public Law 117-169 at Section 50233, August 16, 2022). The ongoing implementation of these efforts will help determine the degree to which revised operations will be implemented.

The Secretary intends to use this SEIS NEPA process to facilitate implementation of Section 7.B.2 of the 2007 Interim Guidelines with respect to the potential implementation of the alternatives.

Allocation of Colorado River water to Mexico is governed by the 1944 Water Treaty. To assess the potential effects of the alternatives in this SEIS, certain modeling assumptions (discussed in **Chapter 3**) are used that display projected water deliveries to Mexico. These assumptions include continued implementation of Minute 323 to the 1944 Water Treaty.

2.6 No Action Alternative

The No Action Alternative describes the continued implementation of existing agreements that control operations of Glen Canyon and Hoover Dams. These include the 2007 Interim Guidelines for the remainder of the interim period (through the 2026 operating year) and agreements adopted pursuant to the DCPA (Public Law 116-14).

2.6.1 Shortage Guidelines

Table 2-1, below, shows the Lower Basin shortages under the 2007 Interim Guidelines and contributions under the 2019 DCPs modeled under the No Action Alternative. The applicable operating condition would continue to be based on the August 24-Month Study projections of the January 1 system storage and reservoir water surface elevations for the following operating year.[2]

Figure 2-1 shows a graphical view of Lower Basin shortages and contributions from the 2007 Interim Guidelines and 2019 DCPs modeled under the No Action Alternative.

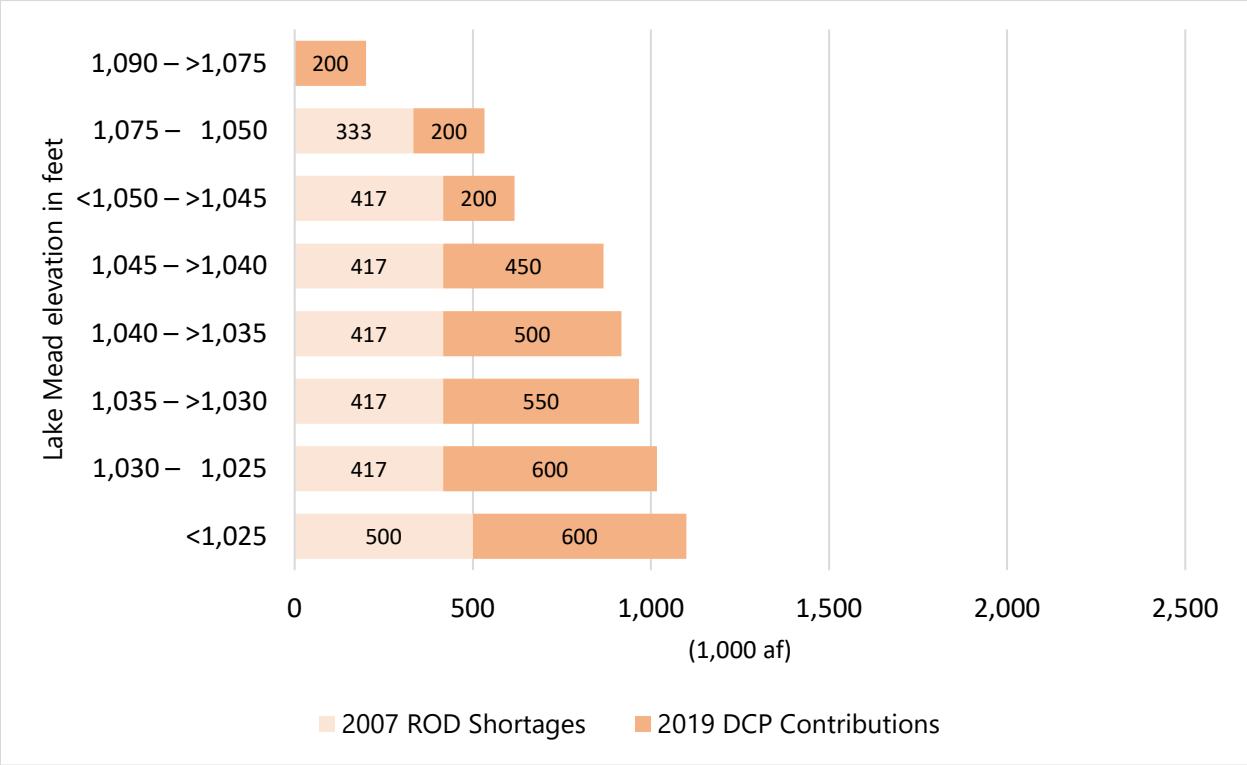
Table 2-1
Lower Division States' Shortages and DCP Contributions, No Action Alternative*

Lake Mead Elevation (feet)	2007 ROD** Shortages (1,000 af)	2019 DCP Contributions (1,000 af)	Total ROD Shortages + Contributions (1,000 af)
1,090 – >1,075	0	200	200
1,075 – 1,050	333	200	533
<1,050 – >1,045	417	200	617
1,045 – >1,040	417	450	867
1,040 – >1,035	417	500	917
1,035 – >1,030	417	550	967
1,030 – 1,025	417	600	1,017
<1,025	500	600	1,100

* This table only shows combined Lower Division State shortage volumes and DCP contributions. In addition to the volumes shown in this table, the analysis for each alternative includes water delivery reductions to Mexico under low-elevation reservoir conditions and Mexico's savings that contribute to the Binational Water Scarcity Contingency Plan (BWSCP), in accordance with Minute 323 to the 1944 Water Treaty (see **Appendix D**, CRMMS Model Documentation, **Tables D-9** and **D-10**).
** Shortages listed in the 2007 ROD

[2] "24-Month Study" refers to the operational study that reflects the current Annual Operating Plan (AOP) that is updated each month by Reclamation to project future reservoir contents and releases. The projections are updated each month using the previous month's reservoir contents and the latest inflow and water use forecasts.

Figure 2-1
Modeled Lower Basin Shortages and DCP Contributions, No Action Alternative



2.6.2 Coordinated Reservoir Operations

Under the No Action Alternative, the annual Lake Powell release is based on the volume of water in storage or the corresponding elevations of Lake Powell and Lake Mead, as described in the Operational Tiers below (see **Table 2-2**).[3] The applicable Operational Tier would continue to be based on the August 24-Month Study projections of the January 1 system storage and reservoir water surface elevations for the following operating year. When Lake Powell's elevation is projected to be above 3,575 feet on January 1, Lake Powell would continue to operate in the Upper Elevation Balancing Tier or Equalization Tier, as described in the 2007 Interim Guidelines.

Mid-Elevation Release Tier

When Lake Powell's elevation is projected to be below 3,575 feet and at or above 3,525 feet on January 1, a release in the amount of 7.48 maf would be made if the projected January 1 elevation of Lake Mead is at or above 1,025 feet. If the projected January 1 Lake Mead elevation is below 1,025 feet, a release of 8.23 maf from Lake Powell would be made.

[3] The operational tiers are described in Sections 6.A through 6.D of the 2007 Interim Guidelines.

Table 2-2
Lake Powell Operational Tiers, No Action Alternative

Lake Powell Operational Tiers (subject to April adjustments or mid-year review modifications)		
Lake Powell Elevation (feet)	**Lake Powell Operational Tier**	**Lake Powell Active Storage** (maf)*
3,700		**23.31**
	Equalization Tier Equalize, avoid spills, or release 8.23 maf	
3,636–3,666 (see Table 2.3-1 in the 2007 FEIS)	**Upper Elevation Balancing Tier** Release 8.23 maf; if Lake Mead <1,075 feet, balance contents with a minimum/maximum release of 7.0/9.0 maf	**14.65–18.36** (2008–2026)
3,575		**8.90**
	Mid-Elevation Release Tier Release 7.48 maf; if Lake Mead <1,025 feet, release 8.23 maf	
3,525		**5.55**
	Lower Elevation Balancing Tier Balance contents with a minimum/maximum release of 7.0/9.5 maf	
3,370		**0**

*Active storage values have been updated from 2007 based on the 2018 bathymetry.

Lower Elevation Balancing Tier

When the projected January 1 Lake Powell elevation is below 3,525 feet, the contents of Lake Mead and Lake Powell would be balanced, if possible, within the constraint that the release from Lake Powell would be no more than 9.5 maf and no less than 7.0 maf.

2.6.3 Implementation of Guidelines

To allow for better overall water management during the interim period, a mid-year review may be undertaken to consider revisions to the AOP based on the April 1 final forecast of the April through July runoff, currently provided by the National Weather Service's (2023) Colorado Basin River Forecast Center, and other relevant factors, such as actual runoff conditions, actual water use, and water use projections. In the mid-year review, the AOP may be modified to make a determination that a different Operational Tier will apply for the remainder of the year or operating year, as appropriate, or that an amount of water other than that specified in the applicable Operational Tier

will be released for the remainder of the year or operating year, as appropriate. Revisions to shortages—compared with the AOP—associated with Lake Mead's elevation determinations in the mid-year review can be revised only to allow for additional deliveries from Lake Mead; they cannot be revised for reduced deliveries.

2.6.4 Drought Contingency Plans

Pursuant to the DCPA (Public Law 116-14), Congress directed the Secretary to carry out a number of drought-related agreements, including mandatory implementation of specific provisions for operation of Colorado River system reservoirs in the Upper and Lower Basins. The agreements include the Upper Basin DCP, which affects operations above Lee Ferry, and the Lower Basin DCP, which affects operations below Lee Ferry (primarily regarding Hoover Dam operations). Both the Upper Basin DCP and the Lower Basin DCP are supplemental to and in furtherance of the goals and operations contained in the 2007 Interim Guidelines.

Continuing current operations of Lake Powell and Lake Mead in extreme low-runoff scenarios would create the potential for water levels in one or both reservoirs to decline below minimum power pool, thereby limiting operation of Glen Canyon Dam or Hoover Dam, or both, to provide water supplies in the Basin. As described in the **Dear Reader Letter**, in such circumstances, the No Action Alternative would perform worse than the Proposed Action in meeting the federal action's purpose of and need for ensuring "that Glen Canyon Dam continues to operate under its intended design" and protecting "Hoover Dam operations, system integrity, and public health and safety" (see **Section 1.3**, Purpose of and Need for Action).

2.7 Proposed Action

This alternative describes a set of actions adopted pursuant to Secretarial authority under applicable federal law. The Proposed Action models changes to operations for both Glen Canyon Dam and Hoover Dam. The Proposed Action includes assumptions for a total of 3.0 maf of SEIS conservation[4] through 2026, with a minimum of 1.5 maf physically conserved by the end of calendar year 2024. This additional conservation would be added onto 2007 Interim Guidelines shortages and DCP contributions and would be implemented across a range of elevations in Lake Mead.

Under the Proposed Action, tier-based reductions and contributions would be limited to the existing 2007 Interim Guidelines, Lower Basin DCP, and Minute 323. Glen Canyon Dam operations would remain consistent with the existing 2007 Interim Guidelines except if Lake Powell is in the Middle Elevation Release Tier or Lower Elevation Balancing Tier, when a mid-year adjustment could be made to reduce the annual volume to no less than 6.0 maf. This mid-year adjustment would be permissible only if the minimum probable scenario in the 24-Month Study shows Lake Powell dropping below 3,500 feet at any point in the following 12 months.

[4] SEIS conservation may be a combination of system conservation, creation of ICS, or other water conservation activities that result in system benefits, as outlined in the proposal. Implementation of conservation measures would be subject to additional environmental compliance, as appropriate.

Whenever Lake Mead's content is projected to be below an elevation of 1,025 feet, based on the April 24-Month Study minimum probable projection, the Lower Division States, after consultation with the Upper Division States, would have 45 calendar days to provide Reclamation with an implementation plan to protect Lake Mead from reaching an elevation of 1,000 feet. If an implementation plan is not acceptable to Reclamation, then Reclamation may take additional action to protect a surface elevation of 1,000 feet.

SEIS conservation up to 2.3 maf is anticipated to be federally compensated. Any remaining required SEIS conservation may be compensated by state or local entities or uncompensated.

All or a portion of the remaining required SEIS conservation may be offset with ICS created in 2023–2026; for any such ICS, the creator could not order delivery, transfer, or assignment of the ICS at any time before December 31, 2026. Because of the limitation on ICS storage space, some DCPs ICS would become system water, which is an uncompensated addition of system water.

For all operations within the scope of the 2007 Interim Guidelines, the Secretary reserves the right to operate Reclamation facilities to address extraordinary circumstances, as described in Section 7(D) of the Guidelines, including "operations that are prudent or necessary for safety of dams, public health and safety, other emergency situations, or other unanticipated or unforeseen activities arising from actual operating experience." The Proposed Action does not identify additional involuntary shortages beyond those already described in the 2007 Interim Guidelines and DCPs. Reclamation would consult and coordinate with tribes, states, and other water users before applying any additional involuntary shortages to protect Lake Mead from reaching an elevation of 1,000 feet or to otherwise address extraordinary circumstances.

2.7.1 Shortage Guidelines

Table 2-3 shows the Lower Basin shortages under the 2007 Interim Guidelines, contributions under the 2019 DCPs, and the additional SEIS conservation modeled under the Proposed Action for operating years 2023 through 2026, with at least 1.5 maf of additional conservation in 2023 and 2024. Assumptions regarding the estimated breakdown of SEIS conservation by state are shown in **Table 2-4**. Lower Division States' SEIS conservation would total at least 3.0 maf in operating years 2023 through 2026, on top of annual 2007 ROD shortages and 2019 DCP contributions.

The total amount of combined 2007 ROD shortages, 2019 DCP contributions, and SEIS conservation, in addition to other additional conservation, cannot exceed 2.083 maf in any given year, as contemplated in the 2007 FEIS.[5] Additional system conservation would require separate NEPA analysis.

Figure 2-2 shows a graphical view of Lower Basin system conservations and contributions from the 2007 Interim Guidelines and the 2019 DCPs plus the additional SEIS conservation modeled under the Proposed Action for operating years 2023 through 2026.

[5] While the 2007 FEIS contemplated reductions up to 2.083 maf, the operating guidelines only provided for reductions up to 500,000 af. Reductions up to 2.083 maf were analyzed in the shortage allocation model in the 2007 FEIS, but impacts analysis up to this amount was not provided for all resources.

Table 2-3
Lower Division States' Shortages, DCP Contributions, and SEIS Conservation, Proposed Action (2023–2026)*

Lake Mead Elevation (feet)	2007 ROD Shortages (1,000 af)	2019 DCP Contributions (1,000 af)	SEIS Conservation (1,000 af)	Total ROD Shortages + DCP Contributions + SEIS Conservation (1,000 af) **
1,090 – >1,075	0	200	Approximately 750 annually**	**950**
1,075 – 1,050	333	200		**1,283**
<1,050 – >1,045	417	200		**1,367**
1,045 – >1,040	417	450		**1,617**
1,040 – >1,035	417	500		**1,667**
1,035 – >1,030	417	550		**1,717**
1,030 – 1,025	417	600		**1,767**
<1,025	500	600		**1,850**

* This table only shows combined Lower Division State shortages, DCP contributions, and SEIS conservation. In addition to the volumes shown in this table, the analysis for each alternative includes water delivery reductions to Mexico under low-elevation reservoir conditions and Mexico's savings that contribute to the BWSCP, in accordance with Minute 323 to the 1944 Water Treaty (see **Appendix D**, CRMMS Model Documentation, and **Tables D-9** and **D-10**).

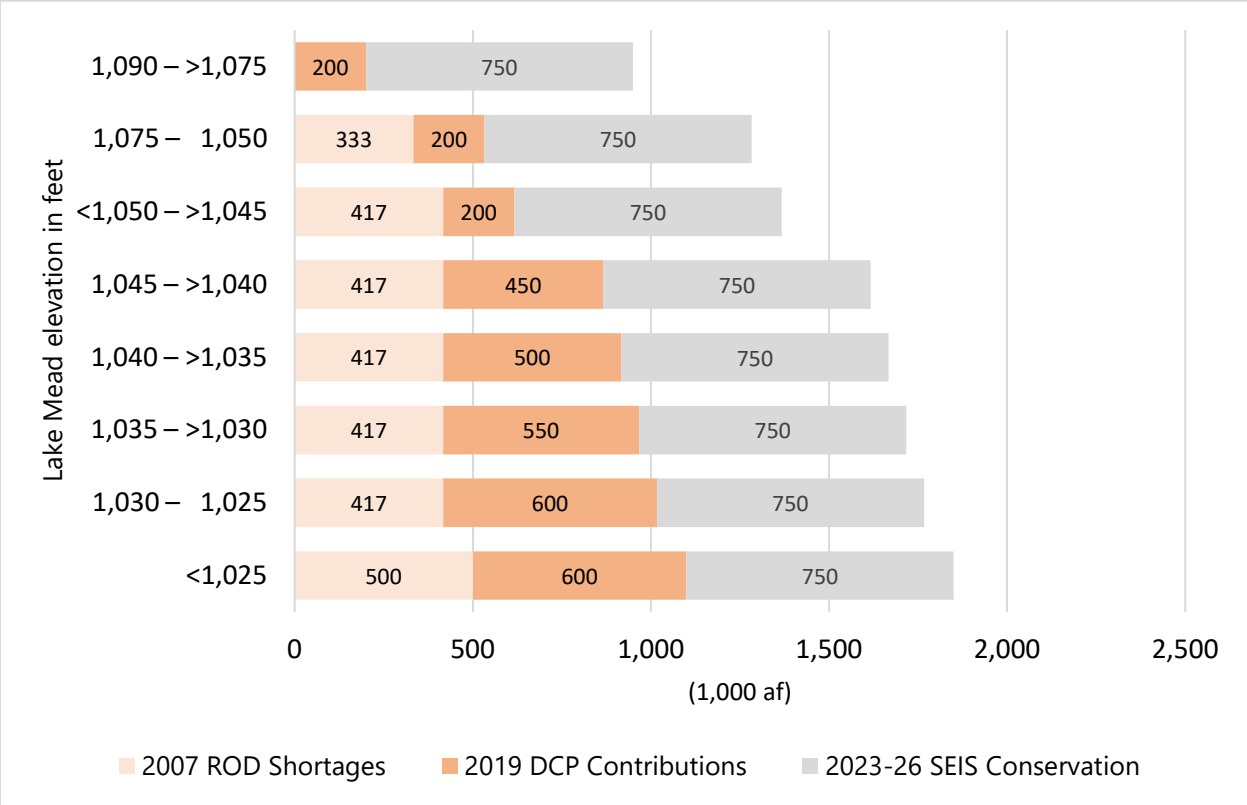
** The amount of SEIS conservation could be higher or lower in a given year depending on the conservation agreements in place in that year. The total of ROD shortages, DCP contributions, SEIS conservation, and any other additional conservation would not exceed 2.083 maf in a given year.

Table 2-4
Lower Division States' Shortages, DCP Contributions, and SEIS Conservation by State, Proposed Action (2023–2026)

Lake Mead Elevation (feet)	2007 ROD Shortages + 2019 DCP Contributions (1,000 af)				Proposed Action Modeled SEIS Conservation (1,000 af)*				Total ROD Shortages + DCP Contributions + SEIS Conservation (1,000 af)			
	AZ	NV	CA	Total	AZ	NV	CA	Total	AZ	NV	CA	Total
1,090 – >1,075	192	8	0	200	280	70	400	750	472	78	400	950
1,075 – 1,050	512	21	0	533					792	91	400	1,283
<1,050 – >1,045	592	25	0	617					872	95	400	1,367
1,045 – >1,040	640	27	200	867					920	97	600	1,617
1,040 – >1,035	640	27	250	917					920	97	650	1,667
1,035 – >1,030	640	27	300	967					920	97	700	1,717
1,030 – 1,025	640	27	350	1,017					920	97	750	1,767
<1,025	720	30	350	1,100					1,000	100	750	1,850

* Estimated annual SEIS conservation volumes in this table are used for comparative analysis purposes only and do not represent annual commitments by each state. Actual SEIS conservation by state may vary each year such that collectively a total of 3.0 maf of SEIS conservation would occur through 2026.

Figure 2-2
Modeled Lower Basin Shortage, DCP Contributions, and Estimated SEIS Conservation, Proposed Action (2023–2026)*



* Actual SEIS conservation may vary each year such that a total of 3.0 maf of SEIS conservation would occur through 2026. Other additional conservation could occur such that it does not exceed a total flow reduction of 2.083 maf as analyzed in the 2007 FEIS.

2.7.2 Coordinated Reservoir Operations

Under the Proposed Action, the annual Lake Powell release would be based on the volume of water in storage or the corresponding elevations of Lake Powell and Lake Mead, as described in the Operational Tiers below (see **Table 2-5**). The Equalization and Upper Elevation Balancing Tiers would be the same as under the 2007 Interim Guidelines.[6] The Mid-Elevation Release Tier and Lower Elevation Balancing Tier would be the same as under the No Action Alternative, with the exception that Reclamation may reduce releases, if needed, to a minimum release of 6.0 maf. Sub-annual releases would comply with LTEMP and would not drop below LTEMP minimum flows, with the goal of keeping the Lake Powell elevation above 3,500 feet, when possible. The applicable Operational Tier would be based on the August 24-Month Study projections of the January 1 system storage and reservoir water surface elevations for the following operating year.

[6] See Sections 6.A, Equalization Tier, and 6.B, Upper Elevation Balancing Tier, in the 2007 ROD published at 73 *Federal Register* 19881 (April 11, 2008).

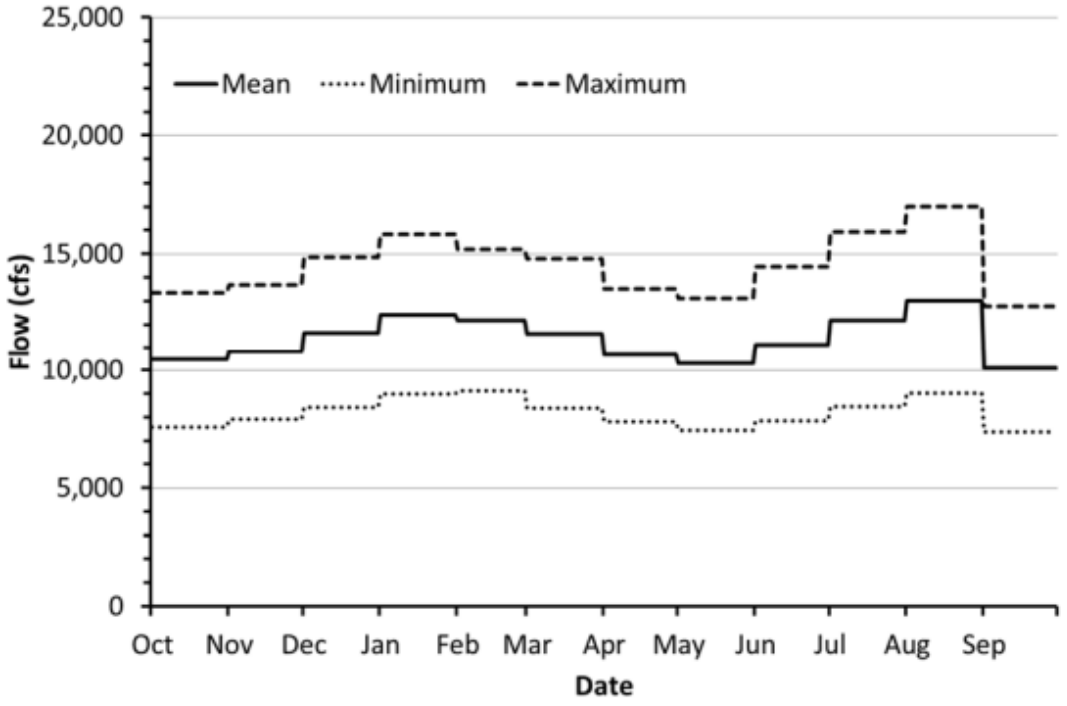
Table 2-5
Lake Powell Operational Tiers, Proposed Action

Lake Powell Operational Tiers (subject to April adjustments or mid-year review modifications)		
Lake Powell Elevation (feet)	**Lake Powell Operational Tier**	**Lake Powell Active Storage*** (maf)
3,700		**23.31**
	Equalization Tier Equalize, avoid spills, or release 8.23 maf	
3,636–3,666 (see Table 2.3-1 in the 2007 FEIS)	**Upper Elevation Balancing Tier** Release 8.23 maf; if Lake Mead <1,075 feet, balance contents with a minimum/maximum release of 7.0/9.0 maf	**14.65–18.36** (2008–2026)
3,575		**8.90**
	Mid-Elevation Release Tier Release 7.48 maf; if Lake Mead <1,025 feet, release 8.23 maf If any minimum probable Lake Powell elevation projection shows Lake Powell <3,500 feet over the next 12 months, reduce releases to a minimum of 6.0 maf to maintain an elevation of 3,500 feet	
3,525		**5.55**
	Lower Elevation Balancing Tier Balance contents with a minimum/maximum release of 7.0/9.5 maf If any minimum probable Lake Powell elevation projection shows Lake Powell <3,500 feet over the next 12 months, reduce releases to a minimum of 6.0 maf to maintain an elevation of 3,500 feet	
3,500		**4.22**
	The Secretary reserves the right to operate Reclamation facilities to protect the Colorado River system if hydrologic conditions require such action	
3,370		**0**

*Active storage values have been updated from 2007 based on the 2018 bathymetry.

Hourly, daily, and monthly releases from Lake Powell for coordinated operations would be consistent with the parameters of the ROD for the LTEMP SEIS (Reclamation and NPS 2016). Monthly releases from Glen Canyon Dam would be distributed proportionally across the remaining months of the operating year for annual releases below 7.0 maf (see **Figure 2-3** for monthly distributions in a year when the annual release is 8.23 maf). Annual flows adjusted mid-year would be distributed to meet the goals of LTEMP, including potential distribution across monthly or experimental flow patterns, and including the unique resource considerations specific to any mid-year annual adjustments.

Figure 2-3
Mean, Minimum, and Maximum Monthly Flows under LTEMP in an 8.23-maf Year



Hourly and daily releases would follow LTEMP parameters, so long as sufficient water is available from the annual release. If sufficient water is not available from the annual release to meet hourly and daily LTEMP release parameters, hourly and daily releases would follow the base operation daily and nightly minimum flows (8,000 cfs and 5,000 cfs, respectively), for as long as possible. If sufficient water is not available from the annual release to support the base operation nightly minimum flow of 5,000 cfs, hourly and daily releases would be consistent with the run of the river to match Lake Powell inflows consistent with protecting an elevation of 3,500 feet at Lake Powell.

Mid-Elevation Release Tier

When Lake Powell's elevation is projected to be below 3,575 feet and at or above 3,525 feet on January 1, a release in the amount of 7.48 maf would be made if the projected January 1 elevation of

Lake Mead is at or above 1,025 feet. If the projected January 1 Lake Mead elevation is below 1,025 feet, a release of 8.23 maf from Lake Powell would be made. If any minimum probable scenario in the 24-Month Study shows Lake Powell dropping below 3,500 feet at any point in the following 12 months, an adjustment could be made to reduce the annual Glen Canyon Dam release volume to no less than 6.0 maf while maintaining LTEMP minimum flows subject to run-of-the-river conditions, operational constraints, and prudent operation, as determined by Reclamation, to maintain an elevation of 3,500 feet at Lake Powell.

Lower Elevation Balancing Tier

When the projected January 1 Lake Powell elevation is below 3,525 feet, the contents of Lake Mead and Lake Powell would be balanced, if possible, within the constraint that the release from Lake Powell would be no more than 9.5 maf and no less than 7.0 maf. If any minimum probable scenario in the 24-Month Study shows Lake Powell dropping below 3,500 feet at any point in the following 12 months, an adjustment could be made to reduce the annual Glen Canyon Dam release volume to no less than 6.0 maf while maintaining LTEMP minimum flows subject to run-of-the-river conditions, operational constraints, and prudent operation, as determined by Reclamation, to maintain an elevation of 3,500 feet at Lake Powell.

2.7.3 Implementation of Guidelines

The provisions for a mid-year review are the same as those under the No Action Alternative except that, if the April 24-Month Study minimum probable model in 2024, 2025, and 2026 indicates that the respective end-of-year elevation in Lake Mead will fall below 1,025 feet, the Lower Division States would have 45 calendar days from the publication of the respective 24-Month Study to propose, after consultation with the Upper Division States, an implementable plan to Reclamation to protect Lake Mead from reaching an elevation of 1,000 feet. If such an acceptable plan, as determined by Reclamation, is not developed, Reclamation may independently take action(s) to protect 1,000 feet.

As described in **Section 2.7**, the Secretary retains the authority to protect the Colorado River system if hydrologic conditions require additional action.

2.8 Alternatives Considered but Eliminated from Detailed Analysis

Reclamation received a number of submissions that represented commentors' intended operations of Colorado River reservoirs. Some submissions presented sufficient detail to potentially be considered as an action alternative. Others presented operational concepts (or components) that could potentially be used to develop a full action alternative. In either case, the following are described as "alternatives" that were brought forward during internal and public scoping. They were considered but eliminated from detailed analysis because they (1) would not fully meet the purpose and need (see **Section 1.3**); (2) are covered by the range of the alternatives; or (3) are infeasible or inconsistent with the basic policy objectives for Colorado River operations, including consistency with applicable federal laws.

Action Alternatives 1 and 2 from the original Draft SEIS were eliminated from detailed consideration in the revised Draft SEIS and this Final SEIS for the reasons described in the **Dear Reader Letter**. Summaries of these alternatives and the rationale for eliminating them are also included in the sections below.

2.8.1 Fill Lake Powell First

Comments received during scoping proposed consideration of a recreation-based alternative that would prioritize filling Lake Powell to higher elevations, such as 3,588 feet, to serve recreational boating needs and to provide resulting benefits to mental health and local economic conditions. This alternative was not carried forward for detailed analysis because it does not meet the purpose, need, or objectives of the federal action (which focus on the critically low elevations impacting operations of both Glen Canyon and Hoover Dams during the interim period [prior to January 1, 2027]). It would not allow compliance with essential water delivery requirements, including the Law of the River and the 2007 Interim Guidelines. It also would not comply with other federal requirements and regulations, including the GCPA and the Lower Basin Drought Contingency Plan Agreement (2019).

Both the 2007 Interim Guidelines and the 2019 DCPs contemplate the need for additional measures to protect Lake Mead elevations. The DCPs added the commitment of participating Lower Basin DCP parties to "individual and collective action in the Lower Basin to avoid and protect against the potential for the elevation of Lake Mead to decline to elevations below 1,020 feet."

An alternative prioritizing recreation uses would not satisfy Reclamation's basic policy objectives and the requirements of the purpose of and need for Reclamation's action to protect both Glen Canyon Dam and Hoover Dam operations, system integrity, and public health and safety. It also would not comport with existing Colorado River law that governs allocation, appropriation, development, and exportation of the waters of the Basin. For these reasons, the alternative was not carried forward for detailed analysis.

2.8.2 Decommission Glen Canyon Dam or Operate for Run of the River

Comments received during scoping proposed either removing Glen Canyon Dam or leaving it in place while operating it to release only inflows or run of the river. Proponents of this alternative assert that it would create new recreational activities; restore the environmental, recreational, and cultural resources of the Grand Canyon and the Basin to their pre-dam conditions; and positively affect the health of the Colorado River ecosystem.

This alternative would not meet the federal action's purpose (which focuses on the critically low elevations impacting operations of both Glen Canyon and Hoover Dams during the interim period [prior to January 1, 2027]) and need (which is based on the potential that continued low-runoff conditions could lead Lake Powell and Lake Mead to decline to critically low elevations, which would impact operations through the remainder of the interim period). Congress authorized the construction and operation of Glen Canyon Dam for specific purposes, and those congressional purposes cannot be met if the dam is decommissioned or not operated as designed. This proposed alternative, for example, would not allow compliance with water release requirements, including, but

not limited to, the division and apportionment of the use of the waters of the Colorado River system under the Compact, as well as other portions of the Law of the River and 2007 Interim Guidelines.

This proposed alternative also would not comport with existing Colorado River law requiring that allocation, appropriation, development, and exportation of the waters of the Basin be consistent with Congress's clear direction to the Secretary to operate Glen Canyon Dam under the Law of the River. For these reasons, the alternative was not carried forward for detailed analysis.

2.8.3 Fill Lake Mead First

As a counterpoint to the "Fill Lake Powell First" alternative discussed above, proponents of this alternative advocate for shifting primary water storage from Lake Powell to Lake Mead, using Lake Powell as a backup for seasonal and flood control purposes to meet the goals of reducing evaporation and seepage and increasing flexibility for implementing Grand Canyon restoration strategies.

This alternative would not meet the federal action's purpose (which focuses on the critically low elevations impacting operations of both Glen Canyon and Hoover Dams during the interim period [prior to January 1, 2027]), and need (which is based on the potential that continued low-runoff conditions in the Basin could lead Lake Powell and Lake Mead to decline to critically low elevations, which would impact operations through the remainder of the interim period).

This proposed alternative, for example, would not allow compliance with water release requirements, including, but not limited to, the division and apportionment of the use of the waters of the Colorado River system under the Compact, as well as other portions of the Law of the River and 2007 Interim Guidelines. This alternative also would not comport with existing Colorado River law requiring that allocation, appropriation, development, and exportation of the waters of the Basin be consistent with Congress's clear direction to the Secretary to operate Glen Canyon Dam under the Law of the River. For these reasons, the alternative was not carried forward for detailed analysis.

2.8.4 One-Dam Alternative

Comments received during scoping proposed an alternative that prioritizes the preservation of one dam and reservoir (Hoover Dam/Lake Mead or Glen Canyon Dam/Lake Powell) over the other. Consistent with the reasons set forth in the above discussions of "Fill Lake Powell First" and "Fill Lake Mead First," this alternative was not carried forward for detailed analysis.

2.8.5 Evaporation, Seepage, and System Losses

Comments received during scoping, as well as the proposal submitted by six Basin States (Arizona, Colorado, Nevada, New Mexico, Utah, and Wyoming), proposed that Reclamation consider an alternative that apportions among all contractors reductions to account for water evaporation, seepage, and system losses.

While Reclamation has not carried forward an alternative that focuses explicitly on accounting for evaporation, seepage, and system losses, the Proposed Action contemplates conservation amounts similar to those that would be assessed based on evaporation, seepage, and system loss calculations in the proposals received. Reclamation published in early 2024—separately from this SEIS

process—an informational report addressing potential methodologies to support assessments for evaporation and other system losses in the Basin.

2.8.6 Ecosystem-Based Alternative

Comments received during scoping suggested that Reclamation design an alternative that maintains Colorado River flows and supports ecosystem needs. An ecosystem-based alternative would also include cuts to water allocations and implementation of water conservation measures. Any operation would meet the applicable ecosystem-based requirements under applicable law.

This alternative was not carried forward for detailed analysis because it does not meet the federal action's purpose, need, or objectives. This is because it does not focus on the critically low elevations impacting operations of both Glen Canyon and Hoover Dams during the interim period (prior to January 1, 2027). Apart from concepts of beneficial-use determinations, Reclamation has limited authorities to mandate water conservation measures in the Lower Basin for ecosystem-based purposes.

2.8.7 Worst-Case Drought Alternative

Comments received during scoping suggested that Reclamation design an alternative that is responsive to worst-case drought modeling. Commenters expressed concern that the existing hydrology modeling does not represent the full range of potential drought scenarios and that an alternative is needed to address prolonged drought conditions. Comments requested updated baseflow modeling to reflect current conditions and to account for long-term climate modeling and worsening drought conditions.

The hydrologic modeling examines scenarios based on flows in the Basin over the past 30 years, which includes the driest 23-year period on record. To examine even worse drought conditions, the hydrologic modeling examines Basin flow scenarios with 90 percent and 80 percent of the flows seen over the past 30 years (up to a 20 percent reduction in flows compared with the last 30 years). The improved hydrology from June 2023 described in the **Dear Reader Letter** does not indicate a risk of operating Glen Canyon and Hoover Dams in a situation where the inflow minus losses equals outflow, subject to run-of-the-river conditions during the remainder of the interim period (prior to January 1, 2027).

Reclamation believes the range of hydrology scenarios analyzed is an appropriate worst case to analyze for conditions that might occur between now and 2026, though longer-term trends could continue to worsen. Because the need for this action is to address the potential for continued low-runoff conditions in the Basin to lead Lake Powell and Lake Mead to decline to critically low elevations that would impact operations through the remainder of the interim period (prior to January 1, 2027), an analysis of scenarios that are not reasonably foreseeable between 2024 and 2026 would not meet the purpose of and need for Reclamation's action.

2.8.8 Hydropower Prioritization Alternative

Comments suggested an alternative that includes elevation levels prioritizing preservation of hydropower production and operations and considers the contractual obligations for power delivery.

While Reclamation has not carried forward an alternative that focuses explicitly on prioritizing hydropower production, the Proposed Action contemplates protection of critical reservoir levels and the continued resulting water deliveries that accordingly relate to the ability to generate hydropower. An alternative prioritizing hydropower production over all other purposes—including water delivery—would not satisfy Reclamation's basic policy objectives. It also would not satisfy the requirements of the purpose of and need for Reclamation's action to protect both Glen Canyon and Hoover Dam operations, system integrity, and public health and safety. This is because, in addition to non-hydropower impacts, assuring hydropower operations at one facility could reduce hydropower operations at other facilities. This alternative would also need to be assessed for consistency with governing authorities. Finally, inclusion of similar protection elevations in the Proposed Action provides adequate opportunity for analysis.

2.8.9 Importation of Water

Reclamation received a number of proposals calling for the importation of water (for example, desalinizing and importing water from the Pacific Ocean). These are not considered in detail in this SEIS because the proposals received did not contain sufficient detail to analyze them. Also, they are not actionable during the interim period (before January 1, 2027). Therefore, they do not meet the purpose of and need for Reclamation's action.

2.8.10 Action Alternatives 1 and 2 from the Original Draft SEIS

The action alternatives analyzed in the original Draft SEIS described a set of actions adopted pursuant to Secretarial authority under applicable federal law (see **Appendix C**, Original Draft SEIS Action Alternatives 1 and 2). Unlike current operations that were developed and are being implemented pursuant to Basin-wide consensus (for example, the 2007 Interim Guidelines and the 2019 DCPs), Action Alternatives 1 and 2 modeled changes to operations for both Glen Canyon Dam and Hoover Dam as developed by Reclamation. Action Alternative 1 included assumptions for reduced releases from Glen Canyon Dam and additional Lower Basin shortages based on the concept of priority.[7] Action Alternative 2 included assumptions for reduced releases from Glen Canyon Dam and additional Lower Basin shortages that were not based exclusively on the concept of priority.

While both the 2007 Interim Guidelines and the 2019 DCPs encompass reductions that reflect the priority system, the additional reductions modeled in Action Alternative 2 for the remainder of the interim period assumed distribution in the same percentage across all Lower Basin water users.[8] Total additional shortage volumes for the Lower Basin were modeled to be the same under Action Alternative 2 as under Action Alternative 1. Action Alternatives 1 and 2 both modeled releases

[7] Priority refers to the distribution of Colorado River water in the Lower Division States of Arizona, California, and Nevada as subject to laws, judicial rulings and decrees, contracts, interstate compacts, and operating criteria (known as the "Law of the River"), which apportion available water between the states and establish certain priorities in use.
[8] For example, if the additional shortage amount is 1 maf, the percentage of additional shortage volume is calculated by dividing 1 maf by 7.5 maf, which equals 13 percent. Then, a 13 percent additional reduction is modeled for each Lower Basin water user based on current water use.

between 6.0 and 8.23 maf from Lake Powell when it is below 3,575 feet, with potentially lower releases to preserve the elevation of 3,500 feet.[9]

As described in the **Dear Reader Letter**, based on the June 2023 hydrologic modeling, Action Alternatives 1 and 2 show comparable, though smaller, risks of reaching critical elevations at Lake Powell compared with the No Action Alternative and the Proposed Action; however, they also show increased risk of reaching critical elevations at Lake Mead relative to the Proposed Action (see **Appendix B**). Based on these updated hydrologic modeling results, the Proposed Action would achieve many of the same purpose and need objectives—namely, reducing the potential that continued low-runoff conditions could lead Lake Powell and Lake Mead to decline to critically low elevations, protecting critical infrastructure at both reservoirs, and balancing overall operational risks in the Colorado River Basins Action Alternatives 1 and 2. However, based on the updated hydrology, the Proposed Action would provide additional risk reduction compared with Action Alternatives 1 and 2, while implementing similar flow reductions; therefore, Action Alternatives 1 and 2 were eliminated from detailed analysis in the revised Draft SEIS and Final SEIS.

2.9 Summary Comparison of Alternatives

Summary comparisons of the alternatives identified and analyzed in the SEIS are provided below. **Table 2-6** addresses each of the four sections of the 2007 Interim Guidelines (73 *Federal Register* 19881, April 11, 2008) identified in the NOI to prepare this SEIS (87 *Federal Register* 69042, November 17, 2022). **Table 2-7** provides a comparison of the shortage guidelines elements of the alternatives (Section 2. Determination of Lake Mead Operation During the Interim Period). **Table 2-8** provides a comparison of the coordinated reservoir operations elements of the alternatives (Section 6. Coordinated Operation of Lake Powell and Lake Mead During the Interim Period).

[9] The action alternatives would protect an elevation of 3,500 feet in Lake Powell to provide a buffer above minimum power pool, which is at 3,490 feet.

Table 2-6
Comparison of Alternatives

Alternative	**Shortage Guidelines** (Section 2. Determination of Lake Mead Operation During the Interim Period)	**Coordinated Reservoir Operations** (Section 6. Coordinated Operation of Lake Powell and Lake Mead During the Interim Period)	**Implementation of Guidelines** (Section 7. Implementation of Guidelines)
No Action Alternative	• Shortages from Lake Mead (that is, reduced deliveries to Lower Basin water users) and DCP contributions of 200,000 af at 1,090 feet to 1.1 maf below 1,025 feet. • Shortages are distributed across Lower Basin water users according to priority.	• Below 3,575 feet at Lake Powell, release 8.23 or 7.48 maf (Mid-Elevation Release Tier) or balance releases between 7.0 and 9.5 maf (Lower Elevation Balancing Tier) depending on the operating tier and elevations at Lake Powell and Lake Mead.	• Mid-year review may adjust the Lake Powell Operational Tier up or down or reduce shortages from Lake Mead (allow additional deliveries to Lower Basin water users).
Proposed Action	• Same as the No Action Alternative, plus total of 3.0 maf of SEIS conservation through 2026 with a minimum of 1.5 maf conserved by the end of operating year 2024.	• Same as the No Action Alternative, except below 3,575 feet at Lake Powell, releases could be as low as 6.0 maf. • Sub-annual releases would comply with LTEMP and would not drop below LTEMP minimum flows, with the goal of keeping the Lake Powell elevation above 3,500 feet, when possible. Reclamation may independently take action(s) to protect a surface water elevation of 3,500 feet if needed to protect infrastructure.	• If April 24-Month Study indicates the end-of-year elevation in Lake Mead will fall below 1,025 feet, Lower Division States have 45 calendar days to propose an implementable plan to protect Lake Mead from reaching an elevation of 1,000 feet. If an acceptable plan is not developed, Reclamation may independently take action(s) to protect a surface water elevation of 1,000 feet.

Table 2-7
Comparison of Shortage Guidelines, DCP Contributions, and SEIS Conservation by Alternative (volumes in 1,000 af)*

Lake Mead Elevation (feet)	No Action Alternative (Total Shortages and DCP Contributions)	Proposed Action (Total Shortages, DCP Contributions, and SEIS Conservation)**
1,090 – >1,075	200	950
1,075 – 1,050	533	1,283
<1,050 – >1,045	617	1,367
1,045 – >1,040	867	1,617
1,040 – >1,035	917	1,667
1,035 – >1,030	967	1,717
1,030 – 1,025	1,017	1,767
<1,025	1,100	1,850

* This table only shows combined Lower Division State shortage volumes and DCP contributions. In addition to the volumes shown in this table, the analysis for each alternative includes water delivery reductions to Mexico under low-elevation reservoir conditions and Mexico's savings that contribute to the BWSCP in accordance with Minute 323 to the 1944 Water Treaty (see **Appendix D**, CRMMS Model Documentation, and **Tables D-9** and **D-10**).

** The amount of SEIS conservation could be higher or lower in a given year depending on the conservation agreements in place in that year. The total of the ROD shortages, DCP contributions, SEIS conservation, and any other additional conservation would not exceed 2.083 maf in a given year.

Table 2-8
Comparison of Coordinated Reservoir Operations by Alternative

Lake Powell Elevation (feet)	No Action Alternative	Proposed Action	Lake Powell Active Storage (maf)*
3,700	**Equalization Tier** Equalize, avoid spills, or release 8.23 maf	**Equalization Tier** Equalize, avoid spills, or release 8.23 maf	**23.31**
3,636–3,666 (see Table 2.3-1 in the 2007 FEIS)	**Upper Elevation Balancing Tier** Release 8.23 maf; if Lake Mead <1,075 feet, balance contents with a minimum/maximum release of 7.0/9.0 maf	**Upper Elevation Balancing Tier** Release 8.23 maf; if Lake Mead <1,075 feet, balance contents with a minimum/maximum release of 7.0/9.0 maf	**14.65–18.36** (2008–2026)
3,575	**Mid-Elevation Release Tier** Release 7.48 maf; if Lake Mead <1,025 feet, release 8.23 maf	**Mid-Elevation Release Tier** Release 7.48 maf; if Lake Mead <1,025 feet, release 8.23 maf If any minimum probable Lake Powell elevation projection shows Lake Powell <3,500 feet over the next 12 months, reduce releases to a minimum of 6.0 maf to maintain an elevation of 3,500 feet.	**8.90**
3,525	**Lower Elevation Balancing Tier** Balance contents with a minimum/maximum release of 7.0/9.5 maf	**Lower Elevation Balancing Tier** Balance contents with a minimum/maximum release of 7.0/9.5 maf If any minimum probable Lake Powell elevation projection shows Lake Powell <3,500 feet over the next 12 months, reduce releases to a minimum of 6.0 maf to maintain an elevation of 3,500 feet.	**5.55**
3,500		The Secretary reserves the right to operate Reclamation facilities to protect the Colorado River system if hydrologic conditions require such action	**4.22**
3,370			**0**

*Active storage values have been updated from 2007 based on the 2018 bathymetry.

2.10 Summary of Potential Effects

Table 2-9 presents a summary of the potential effects of the alternatives. **Chapter 3**, Affected Environment and Environmental Consequences, contains detailed descriptions of these effects.

Table 2-9
Summary of Potential Effects of the Alternatives

SEIS Section	Affected Resource	Alternatives	
		No Action	Proposed Action
3.6	**Hydrologic Resources**		
	Reservoir elevations for Lake Powell	There is a higher likelihood of monthly pool elevations for the No Action Alternative dropping below the critical elevation of 3,490 feet than under the Proposed Action. Monthly pool elevations increase over time for the No Action Alternative. Modeled end-of-water-year pool elevations result in a lower median elevation in 2026 and a smaller range of values than the Proposed Action.	The Proposed Action is designed to protect the critical elevation of 3,490 feet and minimizes the likelihood of instances of monthly elevations dropping below this to approximately 2% in 2026. Monthly pool elevations increase over time for both the No Action Alternative and the Proposed Action. Modeled end-of-water-year pool elevations result in median elevations that are the same as the No Action Alternative in 2024 and 2025 and slightly higher in 2026.
	Reservoir elevations for Lake Mead	The median monthly pool elevations are lower than the Proposed Action and exhibit a downward trend through 2026. There is a higher likelihood of monthly pool elevations dropping below the critical elevation of 1,020 feet than under the Proposed Action. Modeled end-of-calendar-year pool elevations have a lower median and a wider range than the Proposed Action, showing more uncertainty over time.	The median monthly pool elevations are higher than the No Action Alternative and exhibit an upward trend. The Proposed Action minimizes the likelihood of monthly pool elevations dropping below the critical elevation to approximately 4% in 2026. Modeled end-of-calendar-year pool elevations have a higher median and a smaller range than the No Action Alternative.

SEIS Section	Affected Resource	Alternatives	
		No Action	**Proposed Action**
3.6 *(cont.)*	Reservoir releases for Glen Canyon Dam (at Lake Powell)	Median annual releases for the No Action Alternative are higher than the Proposed Action and increase in variability through 2026. The modeled median monthly releases are consistently higher than the Proposed Action.	Under the Proposed Action, releases can be reduced to 6.0 maf if elevations in Lake Powell drop below 3,500 feet. This results in median annual releases that are slightly lower than the No Action Alternative. Lower releases from Glen Canyon are also due to the reduced releases during balancing or equalization due to higher elevations in Lake Mead. Median annual releases increase in variability through 2026. Median monthly releases are lower than the No Action Alternative, particularly on the lower end of releases.
	Reservoir releases for Hoover Dam (at Lake Mead)	Median annual releases for the No Action Alternative increase through 2026 with increasing variability. Median annual releases are approximately 0.40 to 0.57 maf higher than the Proposed Action.	Median annual releases for the Proposed Action increase through 2026 and are lower than the releases under the No Action Alternative. Lower releases are a result of SEIS conservation.
	River flows	River flows increase through 2026 for both the No Action Alternative and the Proposed Action. The No Action Alternative results in slightly higher to substantially higher flows than the Proposed Action.	The Proposed Action results in annual releases that increase through 2026 but are lower as compared to the No Action Alternative.
	Groundwater	Groundwater adjacent to Lake Powell may increase due to increasing pool elevations. Increasing river flows downstream of Glen Canyon may result in increases to groundwater. Groundwater adjacent to Lake Mead may decrease due to decreasing pool elevations. Certain portions of the river downstream of Lake Mead are anticipated to have decreased groundwater elevations in the river corridor due to decreasing river flows and shallower river stages.	Groundwater adjacent to Lake Powell may increase due to increasing pool elevations. Increasing river flows downstream of Glen Canyon may result in increases to groundwater. Groundwater adjacent to Lake Mead may increase due to increasing pool elevations. Certain portions of the river downstream of Lake Mead are anticipated to have decreased groundwater elevations in the river corridor due to decreasing river flows and shallower river stages.

SEIS Section	Affected Resource	Alternatives	
		No Action	Proposed Action
3.7	**Water Deliveries**		
	Apportionments in the Upper Division States	No impact.	No impact.
	Apportionments and water entitlements to and within the Lower Division States	No impact.	No impact.
	Lower Division State water supply determinations and total water deliveries	Median modeled combined shortages and DCP contributions are consistent within each state. Combined shortages and DCP contributions gradually decrease over time, likely resulting in fewer impacts on water supply determinations. Combined shortages, DCP contributions, and system conservation also gradually decrease over time, except in Nevada where no system conservation occurs. Median modeled depletions gradually increase over time, generally decreasing impacts on water deliveries.	Median combined shortages and DCP contributions are the same for both alternatives. Slight differences in maximum and minimum volumes occur between alternatives due to differences in the percent of traces at each operating tier. Combined shortages, DCP contributions, and system conservation exceed that of the No Action Alternative each year due to the impacts of SEIS conservation, resulting in greater total impacts on water supply determinations under the Proposed Action. Median modeled depletions gradually increase over time, but at lower volumes than for the No Action Alternative, resulting in greater impacts on water deliveries than under the No Action Alternative.
	Deliveries to Mexico	This SEIS does not consider actions for Mexico. There would be no change to specified reductions and recoverable savings to Mexico. Impacts on modeled reductions and recoverable savings to Mexico are possible as Lake Mead elevations decline.	Minimum modeled deliveries are higher under the Proposed Action than under the No Action Alternative, due to higher minimum elevations at Lake Mead, potentially resulting in reduced impacts on deliveries.
	Modeled distribution of shortages to and within the Lower Division States	Impacts on shortages are fewer initially but increase as reservoir levels decrease. As total shortages analyzed increase, there would be a corresponding increase in shortages allocated to Arizona 4th-priority entitlement holders, Nevada eighth-priority level users, and California DCP contributions.	Impacts on the modeled distribution of shortages are the same as under the No Action Alternative. The addition of SEIS conservation results in greater combined shortages, DCP contributions, and system conservation but could result in reduced mandatory shortages compared to the No Action Alternative.

SEIS Section	Affected Resource	Alternatives	
		No Action	**Proposed Action**
3.7 *(cont.)*	Flows into the Salton Sea	No change to current operational activities results in continuation of the current rate of decreased surface elevation and existing impacts.	The potential for additional system conservation agreements could reduce deliveries, resulting in expedited (but not additional) lakebed exposure compared with the No Action Alternative, due to the possibility of less available agricultural runoff. Lakebed exposure may be greater under the Proposed Action for the next 26 years, as estimated by the Salton Sea Modeling, but long-term impacts are the same as under the No Action Alternative.
3.8	**Water Quality**		
	Salinity	Higher lake levels result in marginally lower salinity concentrations. Modeled salinity varied greatly among the traces.	Higher lake levels result in marginally lower concentrations. Modeled salinity varied greatly between traces; however, salinity concentrations between the No Action and Proposed Action Alternatives are relatively similar.
	Temperature	Projected temperature releases at Glen Canyon Dam and Hoover Dam vary widely among the traces. Below Glen Canyon Dam, some traces exceed the 20°C threshold; however, more than half of the traces simulated are below this threshold for each water year.	Projected temperature releases at Glen Canyon Dam and Hoover Dam vary widely among the traces; however, outcomes are relatively similar between the No Action and the Proposed Action Alternatives. Below Glen Canyon Dam, the Proposed Action leads to slightly more days above 16°C in water year 2026 when compared to the No Action Alternative. As in the No Action Alternative, some traces exceed the 20 °C threshold; however, more than half of the traces simulated are below this threshold for each water year.

SEIS Section	Affected Resource	Alternatives	
		No Action	**Proposed Action**
3.8 *(cont.)*	Sediment	Sediment dredging projects in the reach below Hoover Dam would continue to ensure water deliveries to downstream users. In the Marble and Grand Canyons, each year between 2024 and 2026 spring HFEs would only be triggered approximately 15 percent of the time and fall HFEs would be triggered approximately 70 percent of the time. If Lake Powell drops below 3,500 feet, HFEs are infeasible. Sand deposition would be insufficient to build sandbars. Sandbars would progressively erode from current conditions through 2026.	April and November HFEs trigger occurrences are approximately the same as under the No Action Alternative. However, November releases are slightly lower under the Proposed Action and would result in a 5 percent reduction in HFE implementation probability for 36- and 72- hour durations in November 2024 and 2025.
	Nutrients and algae	Decreased dilution capacity could result in greater concentrations of nitrogen and phosphorus; however, quantified water quality impacts related to dilution capacity are not available, rendering it difficult to project the quantified water quality impacts based on dilution capacity.	Lower flows under the Proposed Action and decreased dilution capacity under all alternatives could result in greater concentrations of nitrogen and phosphorus; however, quantified water quality impacts related to dilution capacity are not available, rendering it difficult to project the quantified water quality impacts based on dilution capacity.
	Dissolved oxygen (DO)	Under the No Action Alternative, mean August to October DO in Lake Powell is projected to drop below 5 mg/L in 79 percent of traces and the percentage of low DO events occurring in the tailwater is projected in 78% of traces.	As in the No Action Alternative, mean August to October DO in Lake Powell is projected to drop below 5 mg/L in 79 percent of traces. The percentage of low DO events occurring in the tailwater would be slightly higher under the Proposed Action (80 percent of traces).
	Metals	The No Action Alternative is unlikely to reduce dilution capacity significantly (a finding similar to that in the 2007 FEIS). Therefore, the projected elevations and corresponding changes in dilution capacity are not expected to result in a significant reduction in dilution capacity or any significant increase in concentrations of metals of concern.	As in the No Action Alternative, the likelihood of drawing down below 1,000 feet is small.

SEIS Section	Affected Resource	Alternatives	
		No Action	**Proposed Action**
3.9	**Air Quality**		
	Shoreline exposure fugitive dust	Increased shoreline exposure results in a potential increase of dust and particulate matter. Under the No Action Alternative, Lake Powell and Lake Mead would have the most acreage of exposed shoreline and therefore the greatest potential for increased fugitive dust emissions. The current shoreline area of the Salton Sea could continue to decrease at the current rate.	Shoreline exposure is anticipated to decrease compared with the No Action Alternative. If IID and CVWD take additional shortages, there would be less inflow to the Salton Sea from irrigation drainage. Salton Sea water surface elevation declines more rapidly under the Proposed Action than the No Action Alternative due to additional consumptive uses on the playa. Exposure may be greater at first under the Proposed Action but would eventually be the same as under the No Action Alternative.
	Alternative power associated with greenhouse gases	The necessity for alternative power (coal and natural gas) results in an increase of greenhouse gases. Under the No Action Alternative, there is less potential for alternative power and therefore less potential for increased greenhouse gas emissions compared with the Proposed Action.	The Proposed Action results in varying degrees of impacts on power generation. The Proposed Action results in more power generation compared with the No Action Alternative under low hydrology scenarios. Annual releases at Lake Mead are higher under the No Action Alternative, leading to less power generation at Hoover Powerplant under the Proposed Action across most hydrologic scenarios, resulting in increased need for alternative power.
3.10	**Visual Resources**		
	Visibility of attraction features	Cathedral in the Desert, and other attraction features inundated by Lake Powell, could be visible and accessible. More of the upstream side of Glen Canyon and Hoover Dams would be visible.	Impacts are similar to those under the No Action Alternative, except less of the upstream side of Glen Canyon and Hoover Dams would be visible.
	Lake Powell maximum height of calcium carbonate ring, 10th percentile, 2025	196 feet	190 feet
	Lake Mead maximum height of calcium carbonate ring, 10th percentile, 2025	204 feet	184 feet

SEIS Section	Affected Resource	Alternatives	
		No Action	**Proposed Action**
3.10 *(cont.)*	Colorado River landscape character	Initially, there would be less impacts as flows would remain above 7.0 maf; however, if Lake Powell reaches dead pool, impacts would be extensive and immediate due to a dramatic reduction in flows.	Impacts would be tempered through different release tiers to keep Lake Powell above 3,500 feet. Releases could be as low as 6.0 maf, if needed, which could result in increased impacts on the river's landscape character.
	Lower Division States' landscape character	Initially, there would be lower impacts; however, if Lake Mead reaches dead pool, dramatic decreases in water availability could affect the landscape character in all three Lower Division States. Based on modeling for the Salton Sea, additional exposure of the lakebed under the No Action Alternative would lead to diminishing scenic quality of landscapes adjacent to the Salton Sea during the planning period (through 2026).	Through application of conservation measures and water supply adjustments, based on lowering elevations of Lake Mead, changes in water availability affecting the landscape character in the Lower Division States would be tempered compared to the No Action Alternative. Management under the Proposed Action, including drought reduction and conservation measures, would expose the Salton Sea's lakebed more quickly than the No Action Alternative during the planning period. This would, further diminish the area's scenic quality through decreasing influence of water within these landscapes. Over the long term, impacts on scenic quality adjacent to the Salton Sea would become similar to the No Action Alternative as modeling predicts a similar amount of lakebed could be exposed through 2045.
3.11	**Cultural Resources**		
	Low lake elevations exposing cultural resources	Low lake levels at Lake Mead would expose resources to increased wave action, wet/dry cycling, and visitation.	Low lake levels at Lake Mead would expose resources to increased wave action, wet/dry cycling, and visitation but to a lesser degree than the No Action Alternative.
	Low river levels exposing cultural resources	River levels and HFEs to deposit sediment would be within ranges previously analyzed under LTEMP.	Conservation measures may lead to lower water levels at the Salton Sea exposing resources.
	Alterations to traditional cultural places	Visitation to archaeological sites may increase if resources are exposed at Lake Mead.	Impacts are the same as under the No Action Alternative.

SEIS Section	Affected Resource	Alternatives	
		No Action	Proposed Action
3.12	**Paleontological Resources**		
	Lower lake levels exposing paleontological resources	Very low lake levels at Lake Mead and Lake Powell would expose paleontological resources to increased wave action, erosion, wet/dry cycling, visitation, and unauthorized collecting.	Low lake levels at Lake Powell and Lake Mead would expose paleontological resources to potential impacts from wave action at lake margins, wet/dry cycles, and likely increased visitation. Projected higher lake levels at Lake Mead would likely expose fewer paleontological resources to potential impacts than the No Action Alternative.
	Lower river levels exposing paleontological resources	Lower river levels would expose more resources to visitation and unauthorized collecting but potentially increase available sediment for wind transport to protect some resources.	Projected higher river levels would expose fewer resources but may make less sediment available for wind transport to protect some resources.
3.13	**Biological Resources**		
	Vegetation	Water elevations are predicted to decrease over time, resulting in short-term changes to riparian vegetation, including an increase in invasive plant species and loss of suitable habitat for native plant species.	The Proposed Action and No Action Alternative result in similar impacts on vegetation at Lake Powell and the Glen Canyon Dam to Lake Mead section until 2025. From 2025 to 2026, the Proposed Action would result in slightly higher water elevations at Lake Powell. At Lake Powell and Lake Mead, fewer acres of shoreline have the potential to be invaded by nonnative species under the Proposed Action compared with the No Action Alternative. In most scenarios, impacts on riparian vegetation in the Glen Canyon Dam to Lake Mead section and the Hoover Dam to the SIB section would be similar under the Proposed Action compared with the No Action Alternative until 2026, when water flows are reduced to these sections to maintain higher water elevations in Lake Powell and Lake Mead.

SEIS Section	Affected Resource	Alternatives	
		No Action	**Proposed Action**
3.13 *(cont.)*	Wildlife	Water elevations are predicted to decrease over time for the driest hydrologic futures. This would result in impacts on wildlife from decreased flows and the reduction of lake levels.	There would be similar impacts to those described under the No Action Alternative for Lake Powell. Water levels are similar compared to the No Action Alternative until 2025, at which point the Proposed Action results in higher water elevations at Lake Powell, reducing impacts on wildlife. Higher water levels at Lake Powell would result in reduced flows from the Glen Canyon Dam to Lake Mead, increasing impacts on wildlife. Similarly, Lake levels are predicted to be higher under the Proposed Action for Lake Mead, resulting in reduced flows from the Hoover Dam to the SIB. This would reduce impacts on wildlife at Lake Mead but increase impacts on wildlife in the Hoover Dam to the SIB section. However, the differences in impacts are likely to be minor.
	Special status species	Water elevations are predicted to decrease over time for the driest hydrologic futures. This would result in impacts on special status species from decreased flows and the reduction of lake levels.	There are impacts similar to those described under the No Action Alternative for Lake Powell. Water levels are similar compared to the No Action Alternative until 2025, at which point the Proposed Action results in higher water elevations at Lake Powell, reducing impacts on special status species. Higher water levels at Lake Powell result in reduced flows from the Glen Canyon Dam to Lake Mead, increasing impacts on special status species. Similarly, Lake levels are predicted to be higher under the Proposed Action for Lake Mead, resulting in reduced flows from the Hoover Dam to the SIB. This would reduce impacts on special status species at Lake Mead but increase impacts on special status species in the Hoover Dam to the SIB section. However, the differences in impacts are likely to be minor.

SEIS Section	Affected Resource	Alternatives	
		No Action	Proposed Action
3.14	**Recreation**		
	Recreation at Lake Powell	Projected Lake Powell elevations are below the critical thresholds for most boat launch facilities, resulting in a reduction in the quality of or the loss of reservoir boating opportunities on Lake Powell. Dock access is unavailable from the Rainbow Bridge National Monument shoreline. Declining pool elevations expose additional areas of Glen Canyon, creating new visitation patterns and resource protection challenges. Sport fish populations are not expected to be impacted.	There are impacts similar to those described under the No Action Alternative, with a lesser magnitude due to the higher maximum projected 2025 pool elevation.
	Recreation from Glen Canyon Dam to Lake Mead	Daytime flows will not drop lower than the safe whitewater boating threshold of 5,000 cfs. Lethal limits for rainbow trout are not projected to be exceeded in any month. If Lake Powell were to reach dead pool beyond 2026, the resulting large increase in water temperature would lead to potentially lethal conditions for rainbow trout.	There are impacts on whitewater boating similar to those described under the No Action Alternative. Predicted release temperatures have more variability annually than under the No Action Alternative, which could lead to greater physiologic stress on rainbow trout under warmer conditions.
	Recreation at Lake Mead	The projected Lake Mead elevation is below the critical threshold for all boat launch facilities except the Pearce Ferry Road launch ramp, which will necessitate boat launch facilities be closed or relocated. The projected median pool elevation for Lake Mead will likely result in boaters encountering boating navigational hazards. Projected surface water temperatures are not anticipated to impact sport fish.	There are impacts similar to those described under the No Action Alternative; however, impacts are slightly reduced due to the slightly higher Lake Mead pool elevations.

SEIS Section	Affected Resource	Alternatives	
		No Action	**Proposed Action**
3.14 *(cont.)*	Recreation from Hoover Dam to the Salton Sea	Flow releases from Hoover Dam, Davis Dam, Parker Dam, and Imperial Dam are within the historical operating range; therefore, there are minimal changes in exposure to boating navigation hazards caused by changes in the river elevation or velocity, changes in access or use of rest areas and take-out points, changes in trip duration caused by changes in river velocity, or decreases in access or use of sport fishing sites caused by changes in flows. The minor changes in water temperatures that may occur downstream of Hoover Dam are not expected to affect warmwater sport fish. Under the No Action Alternative, the Salton Sea shoreline will continue to decrease at the current rate.	There are impacts similar to those described under the No Action Alternative; however, shoreline recreation on the Salton Sea shoreline could be more adversely affected if IID and CVWD contribute to SEIS conservation.
3.15	**Electrical Power Resources**		
	Glen Canyon Powerplant		
	Average annual generation	3,539,401 MWh	3,464,135 MWh
	Average August capacity	544 MW	546 MW
	Average annual total economic value of electrical energy value	$271,395,000	$268,544,000
	Hoover Powerplant		
	Average annual generation	3,106,135 MWh	3,007,348 MWh
	Average August capacity	1,208 MW	1,280 MW
	Average annual total economic value of electrical energy value	$393,479,000	$ 383,784,000
	Parker and Davis Powerplants		
	Average annual generation	1,471,966 MWh	1,394,967 MWh
	Average August capacity	Negligible impacts	Negligible impacts
	Average annual total economic value of electrical energy value	$136,346,000	$127,183,000

SEIS Section	Affected Resource	Alternatives	
		No Action	**Proposed Action**
3.15 *(cont.)*	Changes in the total annual economic value of electrical energy impact on the various power funds	Reduced total hydropower value at Glen Canyon Powerplant results in reduced contributions to the Basin Fund. Reduced total hydropower value at Hoover, Parker, and Davis Powerplants results in reduced contributions to the Development Fund. Continued revenue from surcharges at Hoover, Parker, and Davis Powerplants results in minor impacts on the Dam Fund.	Reduced total hydropower value at Glen Canyon Powerplant results in reduced contributions to the Basin Fund. Reduced total hydropower value at Hoover, Parker, and Davis Powerplants results in reduced contributions to the Development Fund. Continued revenue from surcharges at Hoover, Parker, and Davis Powerplants results in minor impacts on the Dam Fund.
	The basin funds' impacts on other governmental programs	Reduced funds in the Basin Fund and Development Fund result in lower contributions to associated government programs. Continued financial resources in the Dam Fund have minor impacts on the associated government programs.	Reduced funds in the Basin Fund and Development Fund result in lower contributions to associated government programs. Continued financial resources in the Dam Fund have minor impacts on the associated government programs.

SEIS Section	Affected Resource	Alternatives	
		No Action	**Proposed Action**
3.16	**Socioeconomics**		
	Loss of agricultural production and associated jobs, income, and tax revenue for Indian and non-Indian agriculture in Arizona, California, and Nevada from 2024 through 2026	Arizona (Indian and Non-Indian): Production: $57–$114 million loss Jobs: 657–1,613 lost Income: $67–$108 million loss Tax revenue: $10–$24 million loss California: Production: $3–$6 million loss Jobs: 0–75 lost Income: $0–$3 million loss Tax revenue: $0–$1 million loss Nevada: No impacts	Impacts are the same as under the No Action Alternative, with reduced potential to experience the higher range of projected impacts. This is due to reduced potential to reach higher tier shortage levels for agricultural water users. Increased system conservation agreements offset to some degree the level of economic impacts associated with reduced agricultural production. There is insufficient data, however, on the degree to which this compensation would offset the regional economic impacts in the agricultural sector, due to the loss of indirect and induced jobs and income that may not be fully compensated.
	Recreation economic contributions	Economic contributions from recreation in Lake Powell and Lake Mead, river-based recreation, and adjacent land-based recreation as well as national wildlife refuges would continue. Due to anticipated reservoir levels, there is the potential for reduced contributions from reservoir-based recreation due to inaccessibility of boat launches in Lakes Powell and Mead as well as navigational issues. Economic contributions from commercial whitewater rafting are supported under all alternatives due to minimum flow requirements; however, the recreational experience would be impacted by the variation in flow. Reduction in Salton Sea elevation could impact recreation at the Salton Sea (and potentially in the region) due to changes in air quality as a result of shore bed exposure.	Impacts are similar to those described under the No Action Alternative, with a slight reduction in potential impacts on recreation use and associated spending due to the slightly higher Lake Mead and Powell pool elevations. Shoreline recreation on and near the Salton Sea and associated spending could be more adversely affected if the Proposed Action resulted in expedited (but not additional) lakebed exposure compared to the No Action Alternative, due to the possibility of less available agricultural runoff.

SEIS Section	Affected Resource	Alternatives	
		No Action	**Proposed Action**
3.16 *(cont.)*	Municipal and industrial water social and economic contributions	Under all alternatives, allocated water shortages for different water elevations in Lake Mead result in higher domestic water shortages compared with 2021 use levels. The specific economic impacts from domestic and industrial water shortages are unknown due to the variety of approaches municipalities and other entitlement holders utilize in shortage scenarios, including supply-side actions (such as groundwater recharge, water purchase agreements, and alternative water supplies) and demand-side strategies (such as water conservation measures). Under the No Action Alternative, impacts are realized at lower shortage scenarios for Arizona long-term contractors (533,000-af scenario) and Nevada entitlement holders (200,000-af scenario) compared with California; this is due to the modeled effects of the priority system in the 2007 FEIS. At a 1.100-maf shortage scenario, maximum levels of shortage would result in domestic water shortages of 178,590 af in Arizona, 30,000 af in Nevada, and 350,000 af in California (pursuant to the DCPs).	Modeled shortage scenarios under the Proposed Action are the same as under the No Action Alternative; however, the increased level of system conservation and intentionally created surplus result in higher elevations at Lake Mead, with fewer traces at higher-shortage tiers as compared to the No Action Alternative in 2025 and 2026. As a result, the potential to reach higher tier shortage levels for domestic waters users (e.g., those shortages as modeled at 967,000 to 1,100,000 af) is reduced.
3.17	**Environmental Justice**		
	Environmental justice communities	Initially, there are fewer impacts than under the Proposed Action; however, there is an increased potential for disproportionate impacts on environmental justice communities as reservoir levels decrease. The available water supply will be reduced to zero for some Arizona priorities (all 5th- and 6th-priority contracts, CAP agricultural, and other excess) located within the following Arizona environmental justice study area counties: Pinal and Pima. This study area includes two Tribes.	In the longer term, hydrologic models indicate that reservoir levels would be maintained above critical levels for a longer length of time with the implementation of proposed additional system conservations. This would contribute to reduced potential for higher modeled shortages and mandatory shortages to occur, thereby minimizing potential impacts on environmental justice communities. Therefore, impacts on environmental justice communities could be reduced compared with the No Action Alternative in the long term.

SEIS Section	Affected Resource	Alternatives	
		No Action	Proposed Action
3.18	**Indian Trust Assets**		
	Water rights and allocations	Tribal water rights are established by law; however, annual water deliveries may change as a result of shortages. Water deliveries and shortages are shared based on priority and as outlined in a Tribe's water settlement and/or entitlement. Executed system conservation agreements with Tribes are in place.	Impacts are the same as under the No Action Alternative. Executed system conservation agreements with Tribes are in place, with the potential for additional system conservation agreements with Tribes under development.
	Cultural and biological resources	Low river levels expose more cultural resources to visitation. As water elevations decrease, there are short-term changes to riparian vegetation, including an increase of invasive plant species and the loss of suitable habitat for native plant species.	No impacts on biological resources for ITAs occur. As with the No Action Alternative, low river levels expose more cultural resources to visitation.

Chapter 3. Affected Environment and Environmental Consequences

3.1 Introduction

This chapter describes the affected environment and environmental consequences for the resources that could be significantly affected by the alternatives, as described in **Table 1-1**. The affected environment sections describe and update the current conditions, focusing on those that have changed since 2007. The environmental consequences sections provide analysis of the No Action and Proposed Action, as described in **Chapter 2**. The analysis is issue based, addressing the specific relevant concerns identified during scoping for a particular resource. For brevity and to avoid redundancy, the 2007 FEIS (Reclamation 2007) is incorporated by reference.

The methodology and technical assumptions used to analyze the potential impacts on the Colorado River system (such as reservoir elevations, releases, and flows) are described in **Section 3.3**. Additional methodologies and assumptions used to analyze specific resources are described in the appropriate **Chapter 3** resource sections.

3.2 Geographic and Temporal Scope

Like the 2007 FEIS, the SEIS's geographic scope of analysis (also termed study or analysis area) is the Colorado River corridor from the full pool elevation of Lake Powell to the Southerly International Boundary (SIB; see Map 3.2-1 in the 2007 FEIS). For some resources, the impact analysis area differs from this scope to account for the impacts on that specific resource; when different, the impact analysis area is defined in the resource's specific methodology section. Additionally, reservoirs upstream of Lake Powell are operated pursuant to their own criteria, which are not affected by the proposed alternatives.

In addition to the potential impacts that may occur within the mainstream Colorado River corridor, the SEIS alternatives may also affect the water supply available to specific Colorado River water users in the Lower Basin due to system conservation described in the Proposed Action. The following water agency service areas are included in the geographic scope of analysis:

- The Central Arizona Project (CAP) contract service areas, including the Central Arizona Water Conservation District service area and Tribal service areas
- The SNWA service area
- The MWD service area

- Imperial Valley and Coachella Valley service areas
- Tribal reservations

The environmental consequences analysis focuses on the period of operating years 2024 through 2026, during which the alternatives considered would be implemented, as described in **Section 2.4**, Implementation. Although impacts of the proposed alternatives could extend beyond 2026, the analysis does not examine impacts beyond 2026 because Reclamation is preparing a separate EIS to develop the post-2026 operational strategies. This post-2026 EIS will analyze a full range of alternatives and associated impacts.

3.3 Methodology

Hydrologic modeling of the Colorado River system was conducted to determine the potential hydrologic effects of the alternatives. The hydrologic modeling provided projections of potential future Colorado River system conditions (such as reservoir elevations, reservoir releases, and river flows) under the No Action Alternative for comparison with conditions under the Proposed Action. Due to uncertainties associated with future inflows into the system, multiple simulations were performed for each alternative to explore a range of possible future conditions. All statistics calculated are reflective of the hydrologic scenarios and other assumptions used in modeling. They are not intended to suggest actual probabilities of any events occurring; however, it is meaningful to compare statistics across alternatives to differentiate performance. For this reason, the environmental consequences analyses provided in the sections below may discuss the likelihood of certain scenarios or impacts occurring.

Hydrologic modeling also provided the basis for analyzing potential effects of each alternative on other environmental resources, such as recreation, biology, and energy. The potential effects on specific resource issues are identified and analyzed for the Proposed Action and compared with the potential effects on that resource issue under the No Action Alternative. These comparisons are typically expressed in terms of the incremental differences in probabilities (or projected circumstances associated with a given probability) between the No Action Alternative and the Proposed Action.

This section provides an overview of the hydrologic modeling used and the framework within which the many simulations were undertaken. Further details regarding the model and modeling assumptions are also provided in **Appendix D**, CRMMS Model Documentation, and **Appendix E**, Shortage Allocation Model Documentation. For some of the resource analyses, additional modeling using other techniques was needed to analyze the potential effects on particular resource issues. In most of these cases, the output from the hydrologic modeling was used as input to these other models. The methodologies used for the additional modeling are described in each respective resource section of **Chapter 3**.

3.3.1 Alternatives Modeled

A Proposed Action and a No Action Alternative are considered in this SEIS.[1] Each alternative includes specific assumptions with regard to the four sections of the 2007 Interim Guidelines that Reclamation is proposing to modify: **Section 2.D**, Shortage Conditions; **Section 6.C**, Mid-Elevation Release Tier; **Section 6.D**, Lower Elevation Balancing Tier; and **Section 7.C**, Mid-Year Review. Additional details with respect to the modeling assumptions used to represent each alternative are presented in **Section 3.3.4**; **Appendix D** and **Appendix E**.

3.3.2 Period of Analysis

As described in **Section 3.2**, this SEIS addresses guidelines that would be in effect for the remainder of the interim period under the 2007 Interim Guidelines from the 2024 through 2026 operating years for Lower Basin shortages and the coordinated operations of Lake Powell and Lake Mead.

3.3.3 Model Description

Future Colorado River system conditions during the analysis period under the No Action Alternative and the Proposed Action were simulated using Colorado River Mid-term Modeling System (CRMMS). The model framework used for this process is a commercial river modeling software called RiverWare™, a generalized river basin modeling software package developed by the University of Colorado through a cooperative arrangement with Reclamation and the Tennessee Valley Authority. While it uses the same software as Colorado River Simulation System (CRSS), which was the model used for the 2007 FEIS, CRMMS is used to produce mid-term projections of system conditions for outlooks up to 5 years, compared with the longer-term outlooks projected using CRSS.

CRMMS simulates operation of the major reservoirs on the Colorado River and provides information regarding the projected future state of the system on a monthly basis in terms of output variables, including the amount of water in storage, reservoir elevations, dam releases, the amount of water flowing at various points throughout the system, and the diversions to and return flows from water users throughout the system. The basis of the simulation is a mass balance (or water budget) calculation that accounts for water entering the system, water leaving the system (e.g., from consumptive use of water, trans-basin diversions, and evaporation), and water moving through the system (i.e., either stored in reservoirs or flowing in river reaches). Further explanation of the model is provided in **Appendix D**. The model was used to project future conditions of the Colorado River system on a monthly timestep for the period June 2023 through December 2026.

Input data for the model includes monthly unregulated inflow forecasts based on the June 2023 forecast; various physical process parameters, such as evaporation rates for each reservoir; initial reservoir conditions as of May 31, 2023; and the future depletion schedules for entities in the Lower Basin and for Mexico. For the first year of the model run, water depletion schedules use water orders that reflect shortage conditions, DCP contributions, Minute 323, and other signed system conservation agreements. For the remaining years in the model run, water depletion schedules reflect "normal" schedules and represent near-term historical trends in water use. For purposes of

[1] Reclamation analyzed external proposals for alternatives, or components thereof, as further described in **Section 2.1**, Development of the Alternatives.

this SEIS, depletions are defined as diversions from the river less the return flow credits, where applicable.

The rules of operation of the Colorado River mainstream reservoirs, including Lake Powell and Lake Mead, for each alternative are also provided as input to the model. These sets of operating rules describe how water is released and delivered under various hydrologic conditions. Further explanation of the operating rules for each alternative is provided in **Appendix D**.

The future hydrology used as input to the model consisted of three sets of 30 Ensemble Streamflow Prediction (ESP) traces (totaling 90 traces).[2] The three sets are 80 percent, 90 percent, and 100 percent of the official June 2023 unregulated inflow forecast, allowing Reclamation to explore a wider range of low-flow hydrologic scenarios below those experienced during the recent 30 years (1991–2020). See **Appendix D** for additional details on these hydrologic ensembles.

3.3.4 Modeling Assumptions

Assumptions Common to All Alternatives

In addition to the specific operating rules necessary to model each of the alternatives (discussed in **Chapter 2**; **Appendix D**, CRMMS Model Documentation, **Appendix E**, Shortage Allocation Model Documentation, and the following section), the modeling of Colorado River system operations also requires certain assumptions about various aspects of water delivery and system operations common to all alternatives.

CRMMS Assumptions for All Alternatives

Detailed assumptions for CRMMS are in **Appendix D** and are summarized here. Assumptions about reduction of deliveries to the Lower Division States under each alternative are described in **Section 2.6**, **Section 2.7**, and **Section 3.3.5**, below.

- All simulations were performed with a start date of June 2023 and an end date of December 2026.
- If the pool elevation of Lake Powell drops below 3,490 feet, it is assumed that only three of the four river outlet works would be available for use at any given time because of the need for periodic inspections and routine maintenance. Reclamation believes this is a reasonable estimation, given the historical and future operations and maintenance requirements for the river outlet works. Operations may vary from this assumption to address operating considerations at Glen Canyon Dam based on the actual operating experience at lower elevations.
- DCP contributions and intentionally created surplus (ICS) assumptions are consistent with the official June 2023 CRMMS simulation.
- The analysis continues implementation of the 2007 Interim Guidelines, 2016 ROD for the Glen Canyon Dam LTEMP and Glen Canyon Dam Operating Criteria, Minute 323, and the 2019 DCPs for operations of the Glen Canyon and Hoover Dams.

[2] This input is based on an ensemble of unregulated streamflow forecasts developed by the National Weather Service's Colorado Basin River Forecasting Center.

- The analysis for each alternative includes modeled water delivery reductions to Mexico under low-elevation reservoir conditions and Mexico's recoverable water savings that contribute to the BWSCP, in accordance with Minute 323 to the 1944 Water Treaty. This differs from the assumed 16.67 percent of the total shortage analyzed in the 2007 FEIS.
- Hourly, daily, and monthly releases from Lake Powell will be consistent with LTEMP. Minimum flows analyzed in the LTEMP were 5,000 cfs at night and 8,000 cfs during the day. If these minimum flows are not possible due to the projected monthly release volume, the model could simulate flows lower than the minimum flows analyzed in LTEMP.
- For Lower Division State and Mexico use, in the first year of the model run, water depletion schedules use water orders that reflect shortage conditions, DCP contributions, reductions under low-elevation reservoir conditions, BWSCP contributions per Minute 323, and system conservation agreements. For the remaining years in the model run, water depletion schedules reflect "normal" schedules and represent near-term historical trends in water use. The 2007 FEIS consumptive use schedules were based on entitlements. These "baseline/normal" water depletion schedules are then reduced by 2007 Interim Guidelines shortages, DCP reductions, and Minute 323 reductions under low-elevation reservoir conditions and BWSCP contributions.
- It is assumed that modeled annual releases are representative of corresponding modeled annual flows within the reach of Davis Dam to Parker Dam, Parker Dam to Cibola Gage, and Cibola Gage to Imperial Dam.
- The 2022 DROA Plan for May 2022 through April 2023 was amended to suspend 2022 DROA Plan releases as of March 7, 2023. A total DROA release of approximately 463,000 af occurred under the 2022 DROA Plan. The CRMMS modeling does not include any assumptions regarding future DROA releases. Reclamation will attempt to maximize DROA recovery in the Upper Initial Units in operating year 2023 and through April 2024.

Shortage Allocation Model Assumptions for All Alternatives

Detailed assumptions for the Shortage Allocation Model are in **Appendix E** and are summarized below.

- The Shortage Allocation Model assumes a maximum analyzed shortage of 1.1 maf.
- The model distributes available water first among states based on the 2007 ROD and 2019 DCPs and subsequently among the entitlement holders within each state based on priority.

Modeling Assumptions for the No Action Alternative

Section 2.6 describes the No Action Alternative in detail. An overview of assumptions for the No Action Alternative includes the following:

CRMMS

- The No Action Alternative of this SEIS differs from the No Action Alternative in the 2007 FEIS in terms of updated rules to reflect the 2007 Interim Guidelines and DCPs, input hydrology, time horizon, hydrologic demands, and modeling tool (CRMMS).
- Releases from Lake Powell are based on the Operational Tiers outlined in the 2007 Interim Guidelines and described in **Section 2.6**.

- Releases from Lake Mead are based on the Lower Basin condition (normal, shortage, or surplus), as outlined in the 2007 Interim Guidelines, and on the required DCP contributions. DCP contributions and ICS assumptions are consistent with the official June 2023 CRMMS simulation.
- Lower Basin demands are reduced based on system conservation agreements that were finalized prior to the June 2023 CRMMS simulation, consistent with the official June 2023 CRMMS. System conservation volumes are summarized in **Section 3.3.5**.

Modeling Assumptions for the Proposed Action

Section 2.7 describes the Proposed Action in detail. An overview of assumptions for the Proposed Action includes:

CRMMS

- Releases from Lake Powell are based on the Operational Tiers outlined in the 2007 Interim Guidelines (and described in **Section 2.6**) with a potential mid-year adjustment to protect Lake Powell elevation of 3,500 feet. In April, when in Mid-Elevation Release Tier and Lower Elevation Balancing Tier, if Lake Powell is projected to drop below 3,500 feet by the end of the operating year or is already below 3,500 feet, monthly releases are reduced to minimize months below 3,500 feet while releasing up to the original release, and no less than 6.0 maf or the required minimum daily release as defined by LTEMP.
- Releases from Lake Mead are based on the Lower Basin condition (normal, shortage, or surplus), as outlined in the 2007 Interim Guidelines, and on the required DCP contributions. ICS assumptions are consistent with the official June 2023 CRMMS simulation, except for (1) MWD's 2023 Extraordinary Conservation ICS volume, (2) SNWA's 2023 Tributary ICS creation volume, and (3) additional types of ICS converted to system water when the maximum ICS accumulation capacity[3] is reached.[4]
- Lower Basin demands are reduced based on system conservation agreements beyond the volumes included in the official June 2023 CRMMS. The modeled system conservation volumes include executed agreements, agreements under development, and planned operations. These Proposed Action conservation volumes are modeling assumptions, do not represent mandatory shortages, and in no way commit specific water users to these reductions in use. System conservation volumes for the Proposed Action are summarized in **Section 3.3.5**.
- A sensitivity analysis of potential DROA contributions is provided in **Appendix F,** Potential DROA Contributions Sensitivity Analysis on Proposed Action.

[3] In accordance with the Lower Basin DCP, the maximum total amount of Extraordinary Conservation ICS, Binational ICS, and DCP ICS that may be accumulated by the Lower Division States is 2.7 maf.
[4] This assumption affects SNWA ICS activity for 2023–2026.

3.3.5 Shortage Sharing and Water Delivery Reduction Assumptions

A summary of modeling assumptions with respect to the reduction of deliveries to the Lower Division States, including 2007 ROD shortages, 2019 DCP contributions, and SEIS conservation, was provided in **Section 2.7**. **Table 3-1** shows the distribution of 2007 ROD shortages and 2019 DCP contributions by state. Modeling assumptions for SEIS conservation volumes by state, user, and year are summarized in **Table 3-2** and **Table 3-3** for the No Action Alternative and Proposed Action, respectively.

Table 3-1
Lower Division States' Shortages and DCP Contributions by State

Lake Mead Elevation (feet)	2007 ROD Shortages (1,000 af)				2019 DCP Contributions (1,000 af)				Total 2007 ROD Shortages + 2019 DCP Contributions (1,000 af)			
	AZ	NV	CA	Total	AZ	NV	CA	Total	AZ	NV	CA	Total
1,090 – >1,075	0	0	0	0	192	8	0	200	192	8	0	200
1,075 – 1,050	320	13	0	333	192	8	0	200	512	21	0	533
<1,050 – >1,045	400	17	0	417	192	8	0	200	592	25	0	617
1,045 – >1,040	400	17	0	417	240	10	200	450	640	27	200	867
1,040 – >1,035	400	17	0	417	240	10	250	500	640	27	250	917
1,035 – >1,030	400	17	0	417	240	10	300	550	640	27	300	967
1,030 – 1,025	400	17	0	417	240	10	350	600	640	27	350	1,017
<1,025	480	20	0	500	240	10	350	600	720	30	350	1,100

Table 3-2
Lower Division States' SEIS Conservation by State, No Action Alternative (2023–2026)
(All volumes in af)

Modeled SEIS Conservation*	2023	2024	2025	2026	Total
California					
System Conservation					
Palo Verde Irrigation District	58,400	39,800	—	—	98,200
Intentionally Created Surplus					
Metropolitan Water District of Southern California**	209,000	—	—	—	209,000
California Total	**267,400**	**39,800**	**—**	**—**	**307,200**
Arizona					
System Conservation					
Gila River Indian Community	91,950	125,000	125,000	—	341,950
Fort McDowell Yavapai Nation	13,933	13,933	13,933	—	41,799
Central Arizona Project Subcontractors	62,200	42,200	42,200	—	146,600
Mohave Valley Irrigation and Drainage District	12,819	—	—	—	12,819

Modeled SEIS Conservation*	2023	2024	2025	2026	Total
Yuma Mesa Irrigation and Drainage District	13,670	—	—	—	13,670
Gabrych Farms	3,240	3,240	3,240	—	9,720
Arizona Total	**197,812**	**184,373**	**184,373**	**—**	**566,558**
Nevada					
Intentionally Created Surplus					
Southern Nevada Water Authority**	65,000	—	—	—	65,000
Nevada Total	**65,000**	**—**	**—**	**—**	**65,000**
Total Modeled System Conservation	**530,212**	**224,173**	**184,373**	**—**	**938,758**

* These model assumptions reflect projected volumes as of June 2023 from executed agreements and are subject to change. These system conservation volumes are modeling assumptions, do not represent mandatory shortages, and do not commit specific water users to these reductions in use.
** 2024–2026 ICS creation and delivery vary based on modeling assumptions and modeled system conditions, including shortage conditions and available ICS accumulation capacity.

Table 3-3
Lower Division States' SEIS Conservation by State, Proposed Action (2023–2026)
(All volumes in af)

Modeled SEIS Conservation*	2023	2024	2025	2026	Total
California					
System Conservation					
Coachella Valley Water District	35,000	45,000	45,000	—	125,000
Quechan Indian Tribe	13,000	13,000	13,000	13,000	52,000
Palo Verde Irrigation District	78,000	120,000	120,000	83,000	401,000
Bard Water District	—	6,000	—	—	6,000
Imperial Irrigation District	50,000	250,000	250,000	250,000	800,000
Intentionally Created Surplus					
Metropolitan Water District of Southern California**	216,000	—	—	—	216,000
California Total	**392,000**	**434,000**	**428,000**	**346,000**	**1,600,000**
Arizona					
System Conservation					
Gila River Indian Community	91,950	145,000	145,000	20,000	401,950
Fort McDowell Yavapai Nation	13,933	13,933	13,933	—	41,799
San Carlos Apache Tribe	23,275	—	—	—	23,275
Colorado River Indian Tribes	37,000	23,000	23,000		83,000
Central Arizona Project Subcontractors	143,800	129,800	128,800	—	402,400
Mohave Valley Irrigation and Drainage District	12,819	12,819	12,819	—	38,457
Yuma Mesa Irrigation and Drainage District	13,670	13,670	13,670	—	41,010

Modeled SEIS Conservation*	2023	2024	2025	2026	Total
Gabrych Farms	3,240	3,240	3,240	—	9,720
Wellton-Mohawk Irrigation and Drainage District	9,000	12,000	12,000	9,000	42,000
Intentionally Created Surplus					
Arizona ICS Preservation Program	70,000	—	—	—	70,000
Arizona Total	**418,687**	**353,462**	**352,462**	**29,000**	**1,153,611**
Nevada					
Intentionally Created Surplus					
Southern Nevada Water Authority***	75,000	75,000	70,000	65,000	285,000
Nevada Total	**75,000**	**75,000**	**70,000**	**65,000**	**285,000**
Total Modeled SEIS Conservation	**885,687**	**862,462**	**850,462**	**440,000**	**3,038,611**

* These model assumptions reflect projected volumes as of June 2023—from executed agreements, agreements under development, and planned operations—and are subject to change. These SEIS conservation volumes are modeling assumptions, do not represent mandatory shortages, and in no way commit specific water users to these reductions in use.
** 2024–2026 ICS creation and delivery vary based on modeling assumptions and modeled system conditions.
*** Specified ICS creation by SNWA is the minimum ICS creation that will occur in each year. Modeled ICS creation will vary based on modeled system conditions, including shortage conditions and available ICS accumulation capacity.

3.3.6 Salton Sea Modeling

The Salton Sea is a terminal lake in Riverside and Imperial Counties, California. The Department owns and manages lands around the Salton Sea. Lake levels are maintained by runoff from the surrounding Imperial Valley and Coachella Valley watersheds, as well as agricultural runoff from the Imperial Irrigation District (IID) and Coachella Valley Water District (CVWD) originating in the Colorado River Basin. The Salton Sea acts as a sump for agricultural runoff. Reductions in agricultural runoff may impact lake elevations, which, in turn, may impact air quality and shoreline wildlife habitat. The California Natural Resources Agency leads restoration efforts at the Salton Sea. These efforts include implementing 29,800 acres of habitat restoration and dust-suppression projects on lakebed areas to address the receding Sea and exposed lakebed. The Department is actively supporting the State of California in the implementation of its 10-year plan by providing technical resources, funding, and Department-owned lands for project implementation and has, therefore, included it in the analysis area for this SEIS.

Future Salton Sea conditions were modeled using the Salton Sea Accounting Model (SSAM). The SSAM was originally developed by Reclamation in the early 2000s and repurposed by the State of California to assist in its Salton Sea Management Program objectives (California Natural Resources Agency 2018). The SSAM was used to estimate the net impacts of short-term allocation reductions on key metrics such as salinity and exposed playa area. To evaluate impacts, water allocation reduction scenarios for the IID and CVWD were evaluated using the SSAM. A set of scenarios was prepared with different levels of reduction and different fallowing/efficiency considerations by the IID. The model assumptions and outputs were reviewed by the IID, CVWD, Reclamation, and California Natural Resources Agency in a series of meetings in mid- to late-2022. A final set of

updates, which includes the No Action Alternative and Proposed Action, were made in 2023 and are presented in this document.

Model inputs include the initial state of the lake, freshwater inflows, and annual evaporation. To model the alternatives, different system conservation approaches proposed by the IID were used to project lake inflows. The primary outputs of the model are exposed lakebed, elevation, and salinity with data reported on an annual timestep.

3.4 Resource Issues Not Analyzed in Detail

As described in **Section 1.5.2** and **Table 1-1**, some resource issues are not considered potentially significant, given current conditions and the actions considered in the alternatives; therefore, they are not analyzed in this SEIS. **Table 1-1** summarizes the rationale for eliminating resource issues from detailed analysis. Resource issues considered but not analyzed in detail in this SEIS include:

- Geology and soils
- Minerals
- Noise
- Transportation and traffic

3.5 Cumulative Impacts

CEQ regulations (40 CFR 1500 through 1508) implementing the procedural provisions of NEPA define cumulative impacts as:

> "…the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7)."

Cumulative impacts refer to two or more individual impacts that, when considered together, are significant or that compound or increase other environmental impacts. Cumulative impacts can be categorized as additive and interactive. An additive impact results from additions from one kind of source through either time or space. An interactive impact results from more than one kind of source.

This section addresses the cumulative impacts of the proposed alternatives combined with other regional water supply or closely related projects in the region. Closely related projects that could result in significant cumulative impacts are briefly described below. In addition, Reclamation considered other projects, such as the Lake Powell Pipeline Project and specific future state conservation projects, but did not bring them forward for cumulative impacts analysis. This is because the projects are currently too speculative to be considered reasonably foreseeable, do not

closely relate to Basin operations and regional water supply, or would not result in significant cumulative impacts. Additional projects will be considered for analysis of cumulative impacts as part of the post-2026 EIS, as appropriate.

3.5.1 LTEMP SEIS

Reclamation's Upper Colorado Basin Region is preparing an SEIS to the LTEMP ROD and FEIS that will analyze flow options from Glen Canyon Dam to prevent smallmouth bass from establishing below the dam by preventing additional spawning. The LTEMP SEIS will also consider modifying the LTEMP High Flow Experiment (HFE) Protocol to incorporate the latest scientific information available. The decline of water levels in Lake Powell to historically low levels has contributed to record high-water temperature releases through the Glen Canyon Dam. Below the dam, these warm water releases are creating ideal spawning conditions for smallmouth bass, a predatory invasive fish species, and other warmwater nonnatives. If smallmouth bass populations continue to spawn and expand downstream into the Grand Canyon, they will likely become a threat to the federally protected humpback chub and other native fish. The purpose of Reclamation's Preliminary Proposed Action for the LTEMP SEIS is to prevent or delay the establishment of smallmouth bass below the Glen Canyon Dam using dam operations to reduce water release temperatures to minimize the efficacy of additional spawning.

Over the past several decades, scientific information on the use and timing of HFEs has improved understanding of how best to manage tributary-derived sediment supplies below the dam, particularly in low-elevation/low-flow scenarios. Current sediment accounting periods under LTEMP include a spring period from December 1 through June 30 and a fall period from July 1 through November 30. Implementation of HFEs during each accounting period can occur in March–April and October–November. The purpose of Reclamation's Preliminary Proposed Action for the LTEMP SEIS is to consider adjusting sediment accounting periods and implementation windows associated with the HFE Protocol.

3.5.2 Salton Sea

The Salton Sea's continuing decline in elevation and resulting exposure of the lakebed negatively impacts the surrounding communities and reduces the remaining habitat for fish and wildlife. The California Natural Resources Agency, the California Department of Water Resources, and the California Department of Fish and Wildlife are focused on implementing Phase I: 10-Year Plan (10-Year Plan) of the Salton Sea Management Program (SSMP) to improve conditions around the Sea. The 10-Year Plan was released in 2017 and then updated in 2018 to guide the State's projects at the Salton Sea over the next decade (2018–2028). The 10-Year Plan identifies a sequence of habitat and dust control projects around the perimeter of the Salton Sea (California Natural Resources Agency 2018 and 2021).

The US Army Corps of Engineers is preparing an Environmental Assessment for the implementation of the 10-Year Plan projects. Of the total project area (29,800 acres), at least 50 percent would be used to create habitat for fish and wildlife that depend on the Salton Sea ecosystem, and the remainder would support projects to suppress dust (US Army Corps of Engineers 2022).

3.6 Hydrologic Resources

3.6.1 Affected Environment

The 2007 FEIS described how hydrologic resources within the study area, which begins with Lake Powell and extends downstream along the Colorado River to the SIB with Mexico, would be potentially affected by the implementation of the alternatives. The proposed alternatives evaluated in this SEIS could affect the same hydrologic resources, including:

- Reservoir storage, reservoir releases, and corresponding changes in Colorado River flows downstream of the reservoirs
- Groundwater connected to the Colorado River corridor

To analyze potential effects on these resources, the 2007 FEIS presented an overview of the hydrology of the Basin and hydrologic resources by river reach (see **Map 3-1**). The overall characteristics and connectivity of the Basin and reaches remain unchanged from information presented in the 2007 FEIS; however, three factors have affected hydrologic resources in the Basin since publication of the 2007 FEIS:

1) Interim Guidelines were established in December 2007 from the FEIS Preferred Alternative, including several operational refinements, according to the ROD for the Colorado River Interim Guidelines for Lower Basin shortages and coordinated operations for Lake Powell and Lake Mead. These 2007 Interim Guidelines were implemented to "address shortage determinations and coordinated reservoir operations" under drought and low reservoir conditions (Reclamation 2007). As listed in the ROD, the 2007 Interim Guidelines remain in effect for supply and reservoir operating decisions through 2026.
2) In May 2019, the DCPs were signed to address ongoing historic drought in the Basin. In May 2019, components of the Lower Basin DCP were implemented with full implementation occurring during the 2020 operating year. Starting in July 2021, the 2021 Upper Basin DROA, which is part of the Upper Basin DCP, was implemented. Implementation of the 2022 Upper Basin DROA began in May 2022. Management of releases and reservoir water levels continues to be conducted in accordance with these the Lower Basin DCP and the DROA element of the Upper Basin DCP.
3) As described in **Chapter 1**, a key driver for this SEIS is the worsening drought and low-runoff conditions in the Basin, which have continued to alter reservoir storage, releases, and flows.

Map 3-1
Delineated Colorado River Reaches for the SEIS Analysis



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The 2007 FEIS used historical hydrologic conditions within the Basin from 1906 through 2005 to inform how changes in operations could impact hydrologic conditions for the interim period between 2007 and 2026. This SEIS incorporates updated hydrologic information to better describe evolving characteristics of hydrologic resources within the affected environment. The updated information for these resources, organized by river reach, also captures the implementation of the 2007 Interim Guidelines, 2019 DCPs, Minute 323, and drought conditions within the Basin. The updated hydrologic conditions and operations within the Basin were used to inform modeling assumptions within the SEIS.

Hydrologic Overview

The 2007 FEIS presented the hydrology of the Basin, including the various hydrologic resources and river reaches in the Basin. This section provides updated descriptions of hydrologic resources within the Basin through 2022 to capture the worsening drought conditions. It also provides an update to releases and reservoir levels as a result of implementing the 2007 Interim Guidelines and Upper Basin DCP and Lower Basin DCP. The Colorado River Basin Climate and Hydrology: State of the Science (State of the Science) report (Lukas and Payton 2020) provided a comprehensive assessment of Basin hydroclimate conditions and trends through 2019. Key findings from the report are summarized below, updated through 2023, where appropriate.

From 2000 to 2023, the Basin has experienced persistent drought conditions, exacerbated by a warming climate, leading to a 20 percent decrease in average annual Upper Basin (at Lees Ferry) natural flows (Reclamation 2022a). This period, from 2000 to 2023, is the driest 23-year period in more than a century. These conditions amount to a cumulative streamflow deficit, or difference between depletions and streamflow, of about 70 maf relative to 20th-century conditions (Reclamation 2022a). Approximately 92 percent of the natural Basin streamflow originates from the Upper Basin; snowmelt is the primary source of runoff. Historically, the primary driver for the hydrologic drought in the Basin has been below-normal precipitation over the winter, resulting in reduced snowmelt in the spring, but warming temperatures are playing an increasing role as evaporative losses and soil moisture deficits increase.

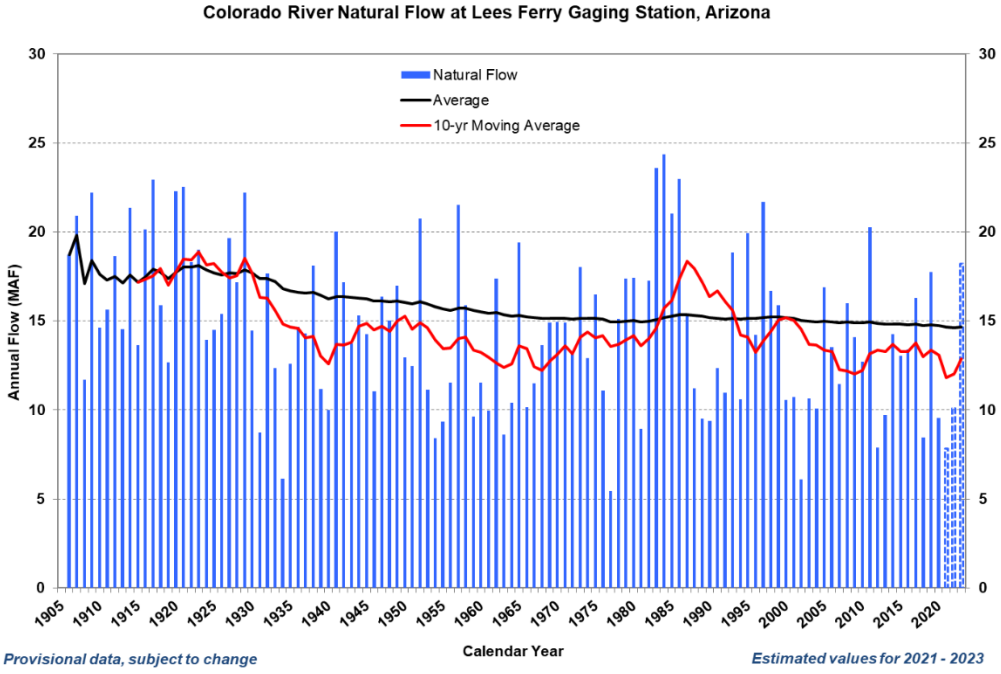
In addition, annual water use in the Basin has exceeded the annual inflows in most years since 2000. This resulted in a depletion of storage to 26 percent of the total combined capacity of Lake Powell and Lake Mead by the end of 2022 (Reclamation 2023b). Since issuance of the 2007 FEIS, the hydroclimate changes in the Basin include further increases in temperature, continued below-normal precipitation, declining snowpack water volume and annual streamflow, and earlier snowmelt runoff. Since 2000, the average temperature across the Basin has been 2°F warmer than the 20th-century average. The warmest 10-year period on record occurred from 2012 to 2021 (National Oceanic and Atmospheric Administration 2023).

To describe precipitation in the Basin, the State of the Science report focused on multi-decadal trends due to the Basin's high interannual variability and the effects of short-term trends associated with the El Niño-Southern Oscillation. For both the Upper Basin and Lower Basin, a declining (but statistically nonsignificant) precipitation trend was noted over the period from 1980 to 2019. During this period, precipitation over the cold season (October through March), which typically falls as snow, showed a greater declining trend than precipitation over the warm-season months. Higher

elevations in the Upper Basin are more resilient to reduced snowpack than the lower elevations; however, studies summarized in the State of the Science report indicate that snowmelt runoff is occurring 1–3 weeks earlier than the average timing prior to 2000.

During the historical period analyzed in the FEIS (1906–2007), the average annual natural flow at the Lees Ferry Gaging Station was 14.916 maf. Annual natural flows during this timeframe ranged from 5.378 maf to 24.356 maf. According to the 2007 FEIS, natural flows at Lees Ferry are calculated based on observed (gage) flow and were corrected for upstream reservoir changes in storage and release, losses including evaporation, and depletions from agricultural and domestic uses. Since the implementation of the 2007 Interim Guidelines (2008 to 2022), the annual natural flow at the Lees Ferry Gaging Station have ranged from 6.733 maf (2021) to 20.303 maf (2011) and averaged 12.674 maf. **Figure 3-1** shows the natural flows (blue) calculated at the Lees Ferry Gaging Station for 1906 through 2023, as well as a running average (black), and 10-year moving average (red).

Figure 3-1
Colorado River Natural Flow at Lees Ferry Gaging Station, Arizona

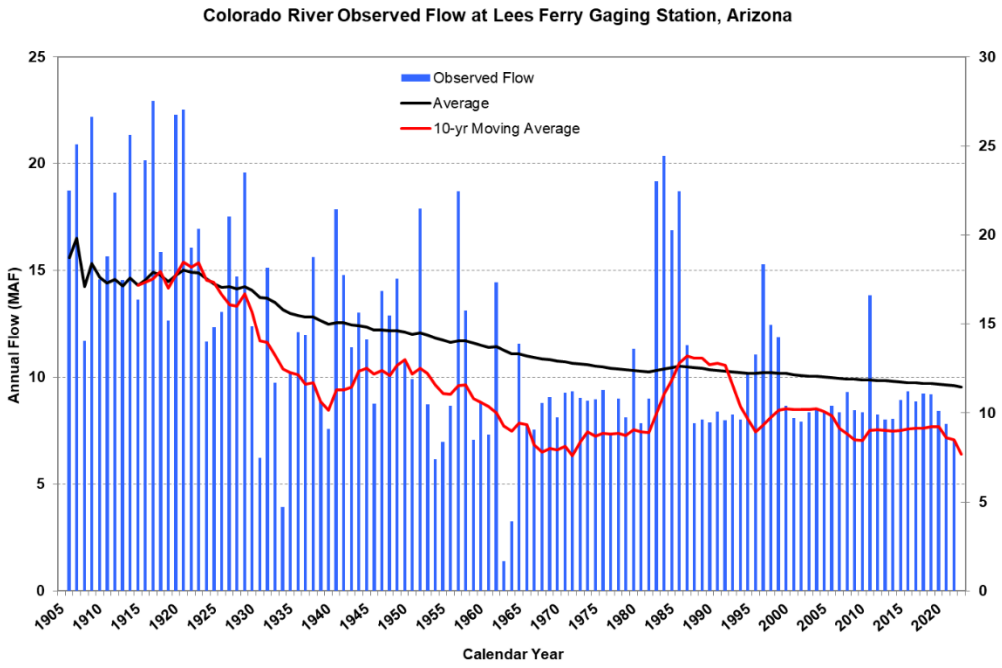


Source: Reclamation 2023c

Beginning in 2008, annual observed flows (as distinct from natural flow with no accounting for the above-mentioned factors) at the Lees Ferry Gaging Station have decreased. The annual observed flow at Lees Ferry during the historical period since the Glen Canyon Dam was built (1963–2007) ranged from 1.383 maf (when the dam was built in 1963) to 20.374 maf (1984), with an average of 9.691 maf noted in the 2007 FEIS. Since the implementation of the 2007 Interim Guidelines (2008 to mid-2023), the annual observed flows at the Lees Ferry Gaging Station have ranged from 7.041 maf to 13.846 maf and averaged 8.877 maf. This average annual observed flow is approximately

0.814 maf less than the average observed flow presented in the 2007 FEIS. The maximum annual observed flow of 13.846 maf occurred in 2011 and was approximately 6.528 maf less than the maximum flow that occurred during the 1963–2007 dataset (in 1984). **Figure 3-2** shows the observed flows recorded at the Lees Ferry Gaging Station for 1906 through mid-2022.

Figure 3-2
Colorado River Observed Flow at Lees Ferry Gaging Station, Arizona



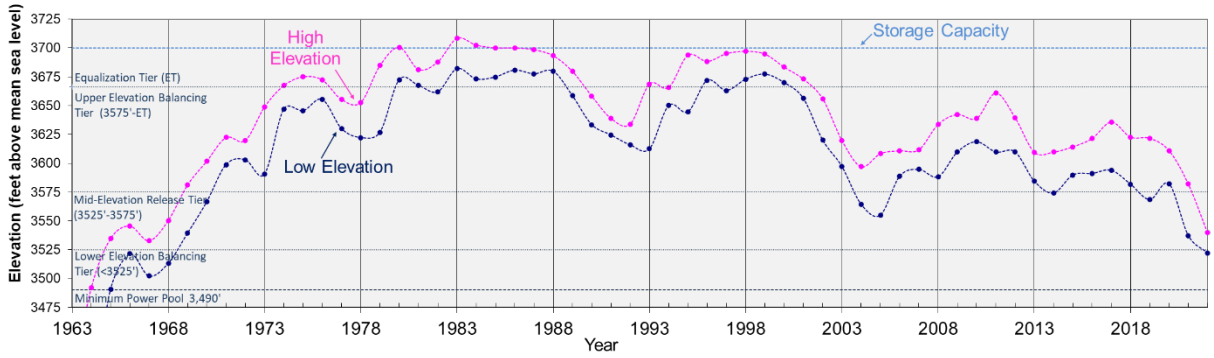
Source: Reclamation 2023c

Lake Powell and Glen Canyon Dam

As presented in the 2007 FEIS, the operating range of Lake Powell is between a water surface elevation of 3,490 feet (corresponding to the minimum power pool) and 3,700 feet (corresponding to the top of the Glen Canyon Dam spillway). Since implementation of the 2007 Interim Guidelines (2008 to 2022), water surface elevations at Lake Powell have been variable, but a steep decline began in 2018. Water surface elevation data were analyzed for 2008 through 2022 from Reclamation's Upper Basin Hydrologic dataset. The operating range during this period was between 3,522.2 feet (2022) and 3,660.9 feet (2011). The average operating elevation was 3,602.3 feet, which is well below the average elevation from 1980-1999.

Since 2017, the annual average water surface elevation at Lake Powell has declined approximately 87 feet. Lake Powell's annual high-water and low-water elevations for 1963 through 2022 are shown in **Figure 3-3**. Note that these data include changes to elevations associated with operation of Lake Powell in accordance with the 2007 Interim Guidelines, the Upper Basin DCP (activated starting in 2020), and the ROD for the Glen Canyon Dam LTEMP.[5] Minimum flows through the Glen Canyon Dam that were analyzed in the LTEMP were 5,000 cfs at night and 8,000 cfs during the day. Possible effects of the Proposed Action on future elevations at Lake Powell are discussed in **Section 3.6.2**, below.

Figure 3-3
Lake Powell Annual High and Low Elevations (1963–2022)



Source: Reclamation 2023c

The 2007 FEIS did not consider effects on groundwater elevations in the vicinity of Lake Powell. Given connections to the groundwater system, it is likely that lower average reservoir elevations result in reduced local groundwater elevations.

Glen Canyon Dam to Lake Mead

As described in the 2007 FEIS, flows in the 265-mile river reach between Glen Canyon Dam and full pool Lake Mead are primarily controlled by Glen Canyon Dam releases from Lake Powell. Additional contributions to this reach of the Colorado River are received from tributaries, including the Paria River and Little Colorado River. Since implementation of the 2007 Interim Guidelines (2008 to 2022), annual inflow from the Little Colorado River ranged from 204,300 af to 392,900 af, averaging 274,600 af. During the same period, the annual inflow from the Paria River ranged from 8,100 af to 27,600 af, averaging 17,600 af. In comparison, during this period, the flows in the Colorado River just below the confluence of the Little Colorado River (USGS gage 09402500) ranged from 7.556 maf to 14.239 maf, averaging 9.311 maf (USGS 2023c). From 2008 to 2022, the inflows from the Paria and Little Colorado Rivers represented approximately 3.1 percent of the average streamflow within this reach of the Colorado River. This is similar to the total contribution of streamflow from the Paria and Little Colorado Rivers to this reach presented in the 2007 FEIS, which was less than 3 percent.

[5] ROD for the Glen Canyon Dam LTEMP FEIS, December 2016. Internet website: https://ltempeis.anl.gov/documents/docs/LTEMP_ROD.pdf.

The 2007 Interim Guidelines have governed annual releases from Glen Canyon Dam since they were implemented in 2008. Under the 2007 Interim Guidelines, the minimum and maximum releases from Glen Canyon Dam are determined by the assigned operating tier for Lake Powell (Equalization Tier, Upper Elevation Balancing Tier, Mid-Elevation Release Tier, or Lower Elevation Balancing Tier). Since 2008 and through 2022, the Upper Elevation Balancing Tier has been the most common operation tier, allowing releases between 7.0 maf and 9.0 maf (see **Table 3-4**). Glen Canyon Dam releases for this period have ranged from 7.04 maf to 13.85 maf and averaged 8.81 maf. The average annual releases presented in the 2007 FEIS from 1996 to 2007 were 9.98 maf. This 1.16-maf decrease in average annual releases can be attributed to hydrologic conditions in the Basin and the implementation of the 2007 Interim Guidelines. Changes to releases from Glen Canyon Dam as a result of the Proposed Action are further discussed in **Section 3.6.2**, Environmental Consequences below.

Table 3-4
Summary of Lake Powell and Lake Mead Coordinated Operations 2008–2022

Year	Lake Powell Operations					Lake Mead Operations
	Operating Tier	April Adjustment	Operating Year Unregulated Inflow (Percent Average)[7]	Release Volume (maf)	Equalization Volume (maf)	Operating Condition
2008	Upper Elevation Balancing	Equalization	126	8.98	0.75	Normal/ICS Surplus
2009	Upper Elevation Balancing	None	106	8.24[1]	—	Normal/ICS Surplus
2010	Upper Elevation Balancing	None	88	8.23	—	Normal/ICS Surplus
2011	Upper Elevation Balancing	Equalization	166	12.52	4.29[2]	Normal/ICS Surplus
2012	Equalization	N/A	51	9.47	1.23[3]	Normal/ICS Surplus
2013	Upper Elevation Balancing	None	53	8.23	—	Normal/ICS Surplus
2014	Mid-Elevation Release	N/A	108	7.48	—	Normal/ICS Surplus
2015	Upper Elevation Balancing	Balancing	106	9.00	—	Normal/ICS Surplus
2016	Upper Elevation Balancing	Balancing	100	9.00	—	Normal/ICS Surplus
2017	Upper Elevation Balancing	Balancing	124	9.00	—	Normal/ICS Surplus
2018	Upper Elevation Balancing	Balancing	48	9.00	—	Normal/ICS Surplus
2019	Upper Elevation Balancing	Balancing	135	9.00	—	Normal/ICS Surplus

Year	Lake Powell Operations					Lake Mead Operations
	Operating Tier	April Adjustment	Operating Year Unregulated Inflow (Percent Average)[7]	Release Volume (maf)	Equalization Volume (maf)	Operating Condition
2020[4]	Upper Elevation Balancing	None	61	8.23	—	Normal/ICS Surplus and DCP Contributions
2021[5]	Upper Elevation Balancing	None	36	8.23	—	Normal/ICS Surplus and DCP Contributions
2022	Mid-Elevation Release Tier	Adjusted in May 2022[6]	63	7.00[6]	—	Level 1 Shortage and DCP Contributions
2023[9]	Lower Elevation Balancing Tier	Balancing[8]	140	8.56	—	Level 2 Shortage and DCP Contributions

Source: Adapted from Reclamation 2020a

[1] In 2009, while the scheduled release volume was 8.23 maf, the actual release was 8.24 maf due to rounding and a release of 5,702 af above 8.23. Balancing did not occur in 2009.

[2] The total 2011 equalization volume was 5.52 maf, with 4.29 maf released in operating year 2011. The remaining equalization volume was released as soon as practicable and was released fully by December 31, 2011.

[3] Although Lake Powell operated in the Equalization Tier in 2011, 8.23 maf was released in operating year 2012 due to dry conditions. The additional release of 1.23 maf was operating year 2011 equalization water released during operating year 2012. The difference between 9.47 maf and 8.23 maf is due to rounding.

[4] Supplemental data for 2020 provided by AOP (Reclamation 2020b)

[5] Supplemental data for 2021 provided by AOP (Reclamation 2021a)

[6] Lake Powell's release was reduced by 480,000 af during Water Year 2022 in May 2022: 2022 Glen Canyon Dam Operations Decision Letter (usbr.gov). Supplemental data for 2022 provided by AOP (Reclamation 2022b).

[7] The unregulated inflow statistics (percentage average) are based on a mean of the 30-year period 1991–2020 for all years.

[8] Supplemental data for 2023, provided by August 2023 Most Probable 24-Month Study (Reclamation 2023d)

[9] 2023 release volume and operating year unregulated inflow based on the August 2023 24-Month Study

As stated in the 2007 FEIS, this reach includes the Grand Canyon, which limits the hydraulic connection to groundwater. The Stream Flow and Losses of the Colorado River in the Southern Colorado Plateau White Paper 5 (White Paper 5) (Wang, J. and Schmidt, J. 2020) states that approximately 150,000 af per year are lost as seepage around the Glen Canyon Dam. The incised nature of this river corridor has remained relatively unchanged since publication of the 2007 FEIS. Based on the 2007 FEIS analyses, the 2007 Interim Guidelines were not anticipated to have affected groundwater levels in this reach; therefore, it is assumed that groundwater levels have remained consistent since 2007 for this reach.

The 2007 FEIS did not consider effects on groundwater elevations in the vicinity of Lake Mead. Given connections to the groundwater system, it is likely that lower average reservoir elevations result in reduced local groundwater elevations.

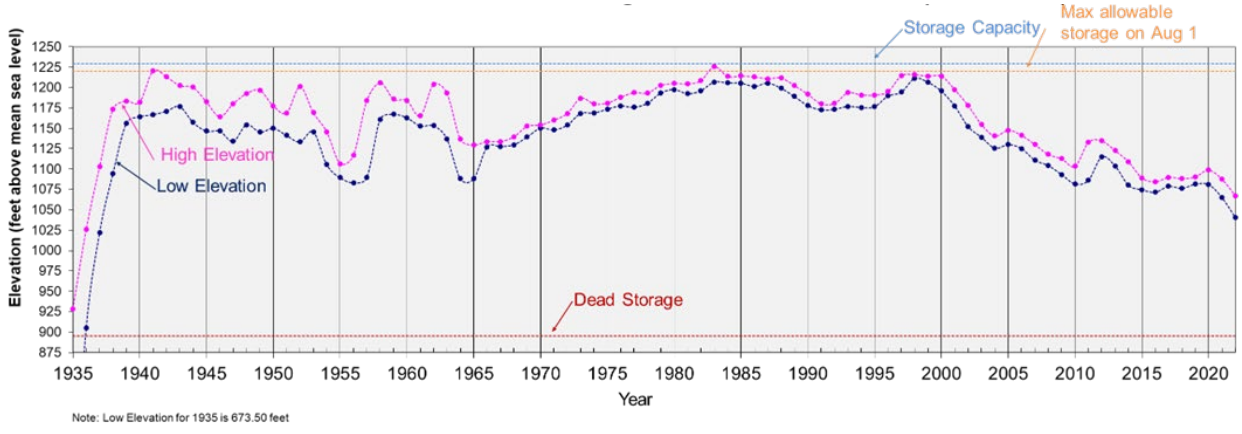
Lake Mead and Hoover Dam

The operating range of Lake Mead is between a water surface elevation of 895 feet and 1,219.6 feet. The top of the Hoover Dam spillway is at elevation 1,221 feet, which allows for 1.5 maf of flood control storage above the maximum operating elevation (1,219.6 feet). Improvements to the Hoover Dam since the 2007 FEIS include the installation of five new wide-head turbines in 2018 to improve hydropower operations at lower water levels. The new turbines lowered the minimum power pool elevation from 1,050 feet to 950 feet. At elevations between 895 and 950 feet, releases occur through the intake towers.

After the construction of the Hoover Dam in 1935, it took Lake Mead approximately 4 years to fill up to an average annual water surface elevation of 1,172 feet. The water surface elevation of Lake Mead was highly variable, fluctuating from 1,098 feet to 1,195 feet, from 1939 until the Glen Canyon Dam and Lake Powell came online in 1963. With the operation of the upstream Glen Canyon Dam, the elevations in Lake Mead began to increase steadily to an average annual peak of 1,215 feet in 1983. Elevations declined slightly through the late 1980s and early 1990s until peaking again in 1998 at an average annual elevation of 1,214 feet. After 1998, elevations began to decline sharply to a new low of 1,118 feet in 2007 when the 2007 Interim Guidelines were implemented. According to the 2007 FEIS, the average annual water surface elevation of Lake Mead during the historical period from 1939 (when Lake Mead filled) through 2007 was 1,170 feet.

Since implementation of the 2007 Interim Guidelines (2008 to 2022), water surface elevations at Lake Mead have generally declined. Water surface elevation data were analyzed for the years 2008 through 2022 from Reclamation's hydrologic database. The annual operating range during this period was between 1,040.6 feet (2022) and 1,134.5 feet (2011). The average annual operating elevation was 1,090.2 feet, which is approximately 71 feet below the average annual water surface elevation from 1939 to 2007. Since 2011, the annual average water surface elevation at Lake Mead has declined approximately 94 feet. **Figure 3-4** shows the annual high-water elevation and annual low-water elevation of Lake Mead for 1935 through 2022.

Figure 3-4
Lake Mead Annual High and Low Elevations (1935–2022)



Source: Reclamation 2023e

As with the data presented above for Lake Powell, the information presented on Lake Mead includes changes to elevations associated with operation of Lake Mead in accordance with the 2007 Interim Guidelines, Minute 323, and the 2019 Lower Basin DCP. Possible effects of the Proposed Action on future elevations at Lake Mead are discussed in **Section 3.6.2**, below.

As discussed in the 2007 FEIS, Hoover Dam releases are managed on an hourly basis to maximize the value of generated power by providing peaks during high-demand periods. A discussion regarding electrical power generation is included in **Section 3.15**.

Since the publication of the 2007 FEIS, Lake Mead operated in a normal/ICS condition each year from 2008 through 2021, in a Level 1 shortage condition in 2022, and in a Level 2a shortage condition in 2023 (see **Table 3-4**). Contributions under the Lower Basin DCP were required from 2020 through 2022. From 2008 through 2022, the elevation of Lake Mead on January 1 has ranged from 1,066.4 feet to 1,114.8 feet.

As reported in the 2007 FEIS, annual Hoover Dam releases from Lake Mead ranged from 8.275 to 12.781 maf and averaged 10.199 maf from 1996 through 2007. With the 2007 Interim Guidelines in place since publication of the 2007 FEIS, annual Hoover Dam releases since 2008 (through 2022) have ranged from 8.515 to 9.615 maf and averaged 9.185 maf. This is a decrease of 1.014 maf in average annual releases. Decreases in releases are due to the ICS activity and surplus guideline operations since the publication of the 2007 Interim Guidelines and the 2000 Interim Surplus Guidelines.

Hoover Dam to Davis Dam

As described in the 2007 FEIS, flows within the 67-mile reach from Hoover Dam (Lake Mead) to Davis Dam (Lake Mohave) are almost entirely comprised of releases from Hoover Dam, with less than 1 percent contributed from tributary inflows.

Implementation of the 2007 Interim Guidelines has reduced the average annual releases from Hoover Dam by approximately 1.014 maf (annually averaging 9.185 maf). The 2007 FEIS modeling results for the alternatives for 2008 through 2026 modeled a 46.7 percent probability of occurrence for Hoover Dam annual releases between 8.01 maf and 9 maf, 40.5 percent for releases between 9.01 maf and 10 maf, and 12.6 percent for releases greater than 10 maf. In comparison, the actual annual Hoover Dam releases since 2008 (through 2022) that were between 8.01 maf and 9 maf occurred approximately 27 percent of the time; releases between 9.01 maf and 10 maf occurred the remaining 73 percent of the time. No releases greater than 10 maf have occurred since the 2007 Interim Guidelines were implemented. The actual observed flows from 2008 to 2022 were different than the modeled flows for the 2007 FEIS federal alternative.

Similar to the alternatives evaluated in the 2007 FEIS, the proposed alternative being evaluated in this SEIS will not change how Hoover Dam is operated on an hourly and daily basis as long as sufficient water is available.

Implementation of the 2007 Interim Guidelines did not affect the target water surface elevation range of Lake Mohave at Davis Dam. Reclamation has continued to operate Lake Mohave under the same rule curve that determines end-of-month target elevations that were used prior to

implementation of the 2007 Interim Guidelines. The water surface elevation continued to range from approximately 630 feet up to 645.7 feet, with lower elevations in the fall to provide flood control capacity and higher elevations in the spring. From 1996 to 2007, the average annual water surface elevation was 640.8 feet. Since 2008 (through 2022), the average annual water surface elevation remained at the same level of approximately 640.9 feet. The average storage in Lake Mohave has remained at approximately 1.6 maf for the last several decades.

As stated in the 2007 FEIS, the upper portion of this reach is within a bedrock canyon that has limited connection to groundwater. Based on the analyses performed in the 2007 FEIS, the 2007 Interim Guidelines were not anticipated to have affected groundwater levels in this reach. Therefore, Reclamation assumed that groundwater levels have remained consistent in this reach since 2007. The lower portion of the reach is dominated by Lake Mohave. The 2007 FEIS did not consider effects on groundwater elevations in the vicinity of Lake Mohave; however, fluctuations of reservoir levels may impact adjacent groundwater levels.

Davis Dam to Parker Dam

As described in the 2007 FEIS, flows within the 84-mile reach from Davis Dam (Lake Mohave) to Parker Dam (Lake Havasu) are primarily comprised of releases from Davis Dam, with inflows from the Bill Williams River entering directly into Lake Havasu. The releases from Davis Dam are made to regulate downstream water demands. These releases are scheduled on an hourly basis and coordinated to meet daily release targets and to help meet power demands.

Implementation of the 2007 Interim Guidelines did not explicitly target the release operations of Davis Dam. However, the annual release rates have decreased since implementing the guidelines and further decreases in flow rates would occur with increasing shortage levels. The current Davis Dam minimum daily release is 1,600 cfs and the minimum hourly release is 1,300 cfs (with monitoring). The minimum release for a 30-day month is currently 95,000 af. As reported in the 2007 FEIS, annual Davis Dam releases from Lake Mohave ranged from 8.0 to 12.6 maf and averaged 9.9 maf from 1996 through 2007. Annual Davis Dam releases since 2008 (through 2022) have ranged from 8.2 to 9.3 maf and averaged 8.8 maf, a decrease of 1.1 maf in average annual releases.

Inflows from the Bill Williams River depend on the releases from Alamo Dam by the USACE; the 2007 Interim Guidelines did not affect these operations. As stated in the 2007 FEIS, the annual inflow from the Bill Williams River ranged from 1,300 to 702,000 af and averaged 102,000 af from 1906 through 2007. Annual Alamo Dam releases since 2008 (through 2022) have ranged from 15.4 af to 501,900 af and averaged 105,000 af. Contributions to Lake Havasu from the Bill Williams River have remained unchanged since implementation of the 2007 Interim Guidelines.

Reclamation has continued to operate Parker Dam at Lake Havasu under the same rule curve that determines end-of-month target elevations as prior to the 2007 Interim Guidelines. The water surface elevation continued to range from approximately 445 feet to 450 feet, with lower elevations in the fall to provide flood control capacity and higher elevations in the spring. From 1996 to 2007, the average annual water surface elevation was 447.5 feet. Since 2008 (through 2022), the average annual water surface elevation has remained at the same level of approximately 447.7 feet. Average storage in Lake Havasu has remained approximately 0.57 maf for the last several decades.

As stated in the 2007 FEIS, the upper portion of this reach is in the Mohave Valley groundwater basin, which is mostly alluvial fill. The 2007 FEIS used a combination of hydrologic and hydraulic models to relate the decreased flow rates to decreased river stage depths, which were used as an indicator for groundwater effects. The 2007 FEIS determined that the 2007 Interim Guidelines would result in decreased groundwater elevations of approximately 0.25 feet to 0.50 feet. Therefore, it is assumed that groundwater levels in this reach have decreased by approximately that much since 2007.

The lower portion of this reach is the Chemehuevi Valley groundwater basin, which is dominated by Lake Havasu. Based on the 2007 FEIS analyses, the 2007 Interim Guidelines were not anticipated to have affected groundwater levels in this reach. Therefore, Reclamation assumes that groundwater levels have remained consistent since 2007.

Parker Dam to Cibola Gage

As described in the 2007 FEIS, flows within the 105-mile reach from Parker Dam (Lake Havasu) to the Cibola Gage primarily consist of releases from Parker Dam. As the last major storage facility on the Colorado River, the releases from Parker Dam are made to regulate downstream water demands.

Implementation of the 2007 Interim Guidelines did not explicitly target the release operations of Parker Dam. These releases are scheduled on an hourly basis and coordinated to meet daily release targets and to help meet power demands. However, the annual release rates have decreased since implementation of the 2007 Interim Guidelines. The current Parker Dam minimum daily release is 1,600 cfs and the minimum hourly release is 1,400 cfs. The minimum release for a 30-day month is currently 95,000 af. As reported in the 2007 FEIS, annual Parker Dam releases from Lake Havasu ranged from 6.19 maf to 10.3 maf and averaged 7.4 maf from 1996 through 2007. Annual Parker Dam releases since 2008 (through 2022) have ranged from 6.2 maf to 6.7 maf and averaged 6.4 maf, a decrease of 1.0 maf in average annual releases.

Operations of the Headgate Rock Dam and Palo Verde Diversion Dam have remained unchanged since publication of the 2007 FEIS. These diversion dams are operated by the BIA and the Palo Verde Irrigation District, respectively.

As stated in the 2007 FEIS, the reach from Parker Dam to the Imperial Dam is in one large groundwater basin (referred to as the Parker Valley, Cibola Valley, and Palo Verde Valley) that is mostly alluvial fill. The 2007 FEIS used a combination of hydrologic and hydraulic models to relate the decreased flow rates to decreased river stage depths, which were used as an indicator for groundwater effects. The 2007 FEIS determined the 2007 Interim Guidelines would result in decreased groundwater elevations of approximately 0.15 feet to 0.30 feet. Therefore, Reclamation assumes that groundwater levels in this reach have decreased by slightly more than 0.15 feet to 0.30 feet since 2007.

Cibola Gage to Imperial Dam

As described in the 2007 FEIS, flows within the 38-mile reach from the Cibola Gage to Imperial Dam are primarily comprised of releases from Parker Dam minus the diversions at Headgate Rock Dam and Palo Verde Dam. The flows in this reach are typically comprised of the United States'

water deliveries for diversions downstream of Palo Verde, including diversions at Imperial Dam, and deliveries to Mexico, as required by the 1944 Water Treaty and Minute 323.

As described above, implementation of the 2007 Interim Guidelines did not change operations of Parker Dam. However, annual releases have decreased since the guidelines' implementation in 2008 due to decreased upstream releases from Lake Powell and Lake Mead and thus, decreased inflows into Lake Havasu. Average flow rates for the Colorado River at the Cibola Gage ranged from 1,488 cfs to 18,168 cfs and averaged 8,931 cfs from the beginning of 1996 through the end of 2007. Average flow rates at the Cibola Gage since January 2008 (through the end of 2022) have ranged from 2,224 cfs to 18,751 cfs and averaged 7,632 cfs, a decrease of average flow rates of 1,299 cfs.

Implementation of the 2007 Interim Guidelines did not affect diversions at Imperial Dam, which meet water deliveries to water districts in the US and Mexico.

As stated in the 2007 FEIS, this reach is in a narrow alluvial fill valley with no adjacent irrigated land. The 2007 FEIS determined the 2007 Interim Guidelines would result in decreased groundwater elevations through this reach. (Refer to the groundwater discussion in the Parker Dam to Cibola Gage reach subsection for details.)

Imperial Dam to NIB

As stated in the 2007 FEIS, flows in the 26-mile reach from Imperial Dam to the Northerly International Boundary (NIB) are primarily comprised of releases from Imperial Dam, return flows from diversions at Imperial Dam, and inflows from the Gila River. The 2007 Interim Guidelines did not alter the operation of these diversions.

As stated in the 2007 FEIS, this reach is in the Yuma Valley groundwater basin and the South Gila Valley groundwater basin, which is small and bounded by rock. However, most water delivery from Imperial Dam to the NIB is via the All-American Canal. Based on the 2007 FEIS analyses, the 2007 Interim Guidelines were not anticipated to have affected groundwater levels in this reach. Therefore, Reclamation assumes that groundwater levels have remained the same since 2007.

NIB to SIB

As stated in the 2007 FEIS, flows in the 23.7-mile reach from the NIB to the SIB are limited. The Morelos Diversion Dam is 1.1 miles downstream of the NIB. Mexico owns, operates, and maintains the Morelos Diversion Dam for Mexico's delivery of flows. Water is diverted from the Morelos Diversion Dam into the Reforma Canal. Flows below the Morelos Diversion Dam in the river reach that extends down to the SIB consist of water in excess of Mexico's scheduled delivery resulting from flood control operations at Hoover Dam and other nontypical hydrologic events, seepage from the Morelos Diversion Dam, irrigation return flows, and groundwater accumulation.

The alternatives evaluated in the 2007 FEIS anticipated that Mexico would continue to operate the Morelos Diversion Dam at the same elevation necessary to ensure the annual 1.5-maf delivery of water, per the 1944 Water Treaty under normal conditions (Mexico agreed to reductions and savings under low elevation reservoir conditions in Minute 323 to the 1944 Water Treaty). The 2007 Interim Guidelines do not affect Mexico's allotment.

The 2007 Interim Guidelines had the potential to impact flows attributed in excess of Mexico's scheduled delivery, since they affected the volume and frequency of flood control releases upstream of Mexico's diversion point. From 1974 through 2012, the average flows to Mexico in excess of scheduled deliveries measured approximately 114,081 af. The Warren H. Brock Reservoir was completed in 2012 with the intent to conserve and reduce excess flows at the NIB. According to the Warren H. Brock Reservoir Conservation Summary Report (Summary Report) (Reclamation 2020c), prior to the completion of the Warren H. Brock Reservoir, the 10-year annual average (2003 through 2012) of flows to Mexico in excess was 82,853 af. Since the completion (through 2019), excess flows to Mexico decreased by approximately two-thirds, saving approximately 56,000 af per year. According to the Summary Report, the future volume of excess flows conserved is variable year-to-year based on hydrologic conditions, rainfall events, and other operational considerations along the lower Colorado River.

As described in the 2007 FEIS, this reach is in the large and deep Colorado River Delta groundwater basin. In the upstream portion of the reach, groundwater provides surface flow to the river (gaining reach) due to the high groundwater elevation in the nearby irrigated lands. In the downstream portion of this reach, groundwater is recharged by the river (losing reach). Based on analyses performed in the 2007 FEIS, the 2007 Interim Guidelines were not anticipated to affect gaining or losing sections of this reach.

Salton Sea

As stated in **Section 3.3.6**, the Salton Sea receives runoff from its surrounding watershed (not the Colorado River Basin) and agricultural runoff that originates in the Colorado River Basin (deliveries). Therefore, discussion regarding the Salton Sea as it relates to hydrologic resources is not necessary and further analysis of the Salton Sea is not included within this section. Please reference **Section 3.7**, Water Deliveries.

3.6.2 Environmental Consequences

Methodology

This section examines the potential effects on hydrologic resources under the No Action Alternative and the Proposed Action. The CRMMS, as described in **Section 3.3**, was used to analyze hydrologic resources. Modeling details for the No Action Alternative and the Proposed Action are described in **Section 3.3.4** and **Appendix D**, CRMMS Model Documentation.

Assumptions

Please refer to **Section 3.3.4**, **Appendix D** and **Appendix E**, Shortage Allocation Model Documentation, for a discussion pertaining to modeling assumptions.

All statistics calculated are reflective of the hydrology scenarios and other assumptions used in modeling and are not intended to suggest actual probabilities of any events occurring. However, it is meaningful to compare statistics across alternatives to differentiate relative performance.

Impact Indicators

For all alternatives, impacts are evaluated using output from the CRMMS model and described based on hydrologic conditions within the Basin as follows:

- **Reservoir Elevations:** Changes to reservoir elevations are described based on a quantitative assessment of projected changes to reservoir water surface elevations for Lake Powell and Lake Mead monthly and on an end-of-water-year basis.
- **Reservoir Releases:** Changes to reservoir releases are described based on a quantitative assessment of projected changes to reservoir releases for Lake Powell and Lake Mead, including release volumes and timings.
- **River Flows:** Changes to river flows are described based on a quantitative assessment of changes in river flows for various reaches, including flow volumes and altered flow patterns. River flows follow the same pattern as reservoir releases.
- **Groundwater:** Changes to groundwater are described based on a qualitative assessment of potential changes to groundwater elevations, including relative changes in river stage and groundwater storage.

Issue 1: How would changes to operational activities affect reservoir elevations?

This section presents a comparison of the No Action Alternative and the Proposed Action in three metrics: monthly pool elevations, annual pool elevations, and percentages of traces below critical elevations at Lake Powell and Lake Mead.

Lake Powell

Summary of Alternatives Comparison

The conclusions in this section are drawn from analyses of three metrics: monthly pool elevations, percentages of traces below critical elevations, and annual pool elevations. Detailed comparisons of the alternatives follow in subsequent sections.

With respect to monthly Lake Powell pool elevations, remaining above 3,490 feet in elevation is critical for preserving infrastructure and ensuring Glen Canyon Dam continues to operate under its intended design for purposes of downstream water releases. Both the No Action Alternative and the Proposed Action result in increased monthly median reservoir elevation at Lake Powell over the period of analysis, with the median Proposed Action elevations being 1 to 6 feet higher than the median No Action Alternative elevations. Under the No Action Alternative, the median monthly elevation starts at 3,567 feet in January 2024 and ends at 3,589 feet in December 2026. The range of modeled elevations under the No Action Alternative is wide, with the lowest trace reaching an elevation of 3,451 feet in December 2026 and the highest trace reaching an elevation of 3,679 feet in June 2026. Only 2 and 7 percent of traces fall below the critical elevation of 3,490 feet (minimum power pool) in 2025 and 2026, respectively, for the No Action Alternative. Under the Proposed Action, the median Lake Powell monthly pool elevation ranges from a minimum of 3,568 feet in January 2024 to 3,592 feet in December 2026. The lowest trace reaches an elevation of 3,467 feet in March 2026 while the highest trace reaches a maximum of 3,686 feet in June 2026. The percentage of traces falling below 3,490 feet under the Proposed Action is 0 and 2 percent in 2025 and 2026, respectively. The median monthly pool elevation for the Proposed Action is the same or slightly

higher than the No Action Alternative and increases throughout the period of analysis. The No Action Alternative has a higher likelihood of monthly pool elevations dropping below the critical elevation of 3,490 feet than the Proposed Action.

The median modeled end-of-water-year Lake Powell pool elevations are the same for the No Action Alternative and the Proposed Action in 2024 and 2025. In 2026, the median pool elevation is 5 feet higher for the Proposed Action than the No Action Alternative. The interquartile range (the difference between the 75th and 25th percentiles) for end-of-water-year elevations in the Proposed Action is a similar width to the No Action Alternative and is approximately 1 to 3 feet higher. Likewise, the 5th to 95th percentile range for end-of-water-year elevations in the Proposed Action is a similar width to than the No Action Alternative and is approximately 0 to 6 feet higher.

Throughout the period of analysis, the No Action Alternative results in lower median monthly elevations, more traces falling below critical elevations, and lower median end-of-water-year elevations than the Proposed Action. Both the No Action Alternative and the Proposed Action result in Lake Powell median pool elevations that increase over the period of analysis. However, the 10th percentile and lower range of modeled elevations decline over time for both actions.

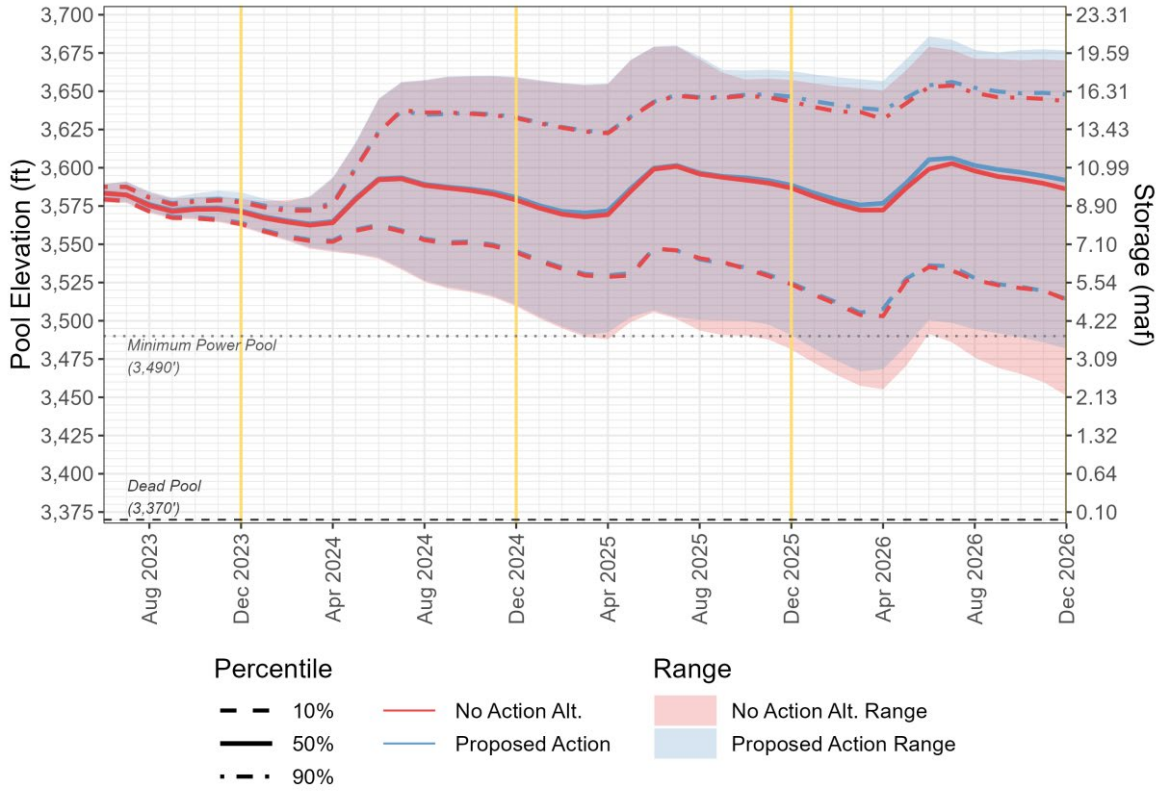
The operational modification included in the Proposed Action is designed to protect a Lake Powell elevation of 3,500 feet. If Lake Powell is in the Middle Elevation Release Tier or Lower Elevation Balancing Tier and the minimum probable scenario in a 24-Month Study shows Lake Powell elevations dropping below 3,500 feet, then the annual release volume can be reduced to 6.0 maf. This modification in the Proposed Action is effective at eliminating instances of falling below 3,490 feet in 2025, and minimizing instances to 2 percent of traces in 2026 (a 5 percent reduction compared to the No Action Alternative). During the period of analysis, all traces for both the No Action Alternative and the Proposed Action remain above the Lake Powell dead pool elevation of 3,370 feet. At dead pool, only flows that reach the reservoir, minus any diversions or losses, can be released downstream.

Monthly Pool Elevations

Figure 3-5 presents a comparison of the 10th, 50th, and 90th percentiles of modeled Lake Powell elevations for both alternatives as dashed, solid, and dash-dotted lines, respectively. It also shows "clouds" representing the full ranges of modeled elevations for both alternatives through 2026.

The full range of modeled Lake Powell elevations from the No Action Alternative is shown by the red cloud in **Figure 3-5**, which spans from a low of 3,451 feet to a high of 3,679 feet in 2026, with fluctuations corresponding to seasonal reservoir levels. The bottom of the No Action Alternative cloud, which results from drier modeled traces, falls to 3,481 feet in 2025 and then to 3,451 feet in 2026. Beginning in 2026, the drier modeled traces result in pool elevations at Lake Powell that drop below the critical elevation of 3,490 feet but remain above the dead pool elevation of 3,370 feet. The top of the No Action Alternative cloud, which results from wetter modeled traces, rises to a high of 3,679 feet in 2025 and 2026. This increasing range in monthly pool elevations is consistent with increasing uncertainty over time.

Figure 3-5
Lake Powell End-of-Month Pool Elevations



The clouds for the No Action Alternative (red) and the Proposed Action (blue) are nearly completely overlapping until August 2025, when the range of the No Action Alternative cloud drops below the Proposed Action. From mid-2025 through the end of 2026, there is a clear distinction between the No Action Alternative and the Proposed Action, where the Proposed Action has both a higher minimum elevation and higher maximum elevation than the No Action Alternative. The higher minimum pool elevation in the Proposed Action results from reduced releases from Glen Canyon Dam to protect 3,500 feet. Monthly pool elevations in the Proposed Action drop below 3,500 feet since Glen Canyon Dam releases are constrained by minimum LTEMP and water releases. In 2025, the minimum modeled elevation for the Proposed Action is 3,491 feet, or 10 feet higher than the lowest elevation of the No Action Alternative elevation (3,481 feet). The minimum elevation of the Proposed Action in 2026 is 3,467 feet, or 16 feet higher than the No Action Alternative (3,451 feet).

In **Figure 3-5**, the median modeled elevations for the No Action Alternative range between a minimum of 3,561 feet and a maximum of 3,593 feet in 2024. The end-of-calendar year (December) median increases from 3,579 feet to 3,587 feet from 2024 to 2025. The median December elevation in 2026 is 3,586 feet. The December median elevations for the Proposed Action are approximately 2 feet higher than the No Action Alternative in 2024 and 2025, and increases to 6 feet higher at the end of 2026. The difference in the median is due to slightly lower balancing releases from Lake

Powell in the Upper and Lower Elevation Balancing Tier resulting from increased storage in Lake Mead (see *Issue 2*)[6].

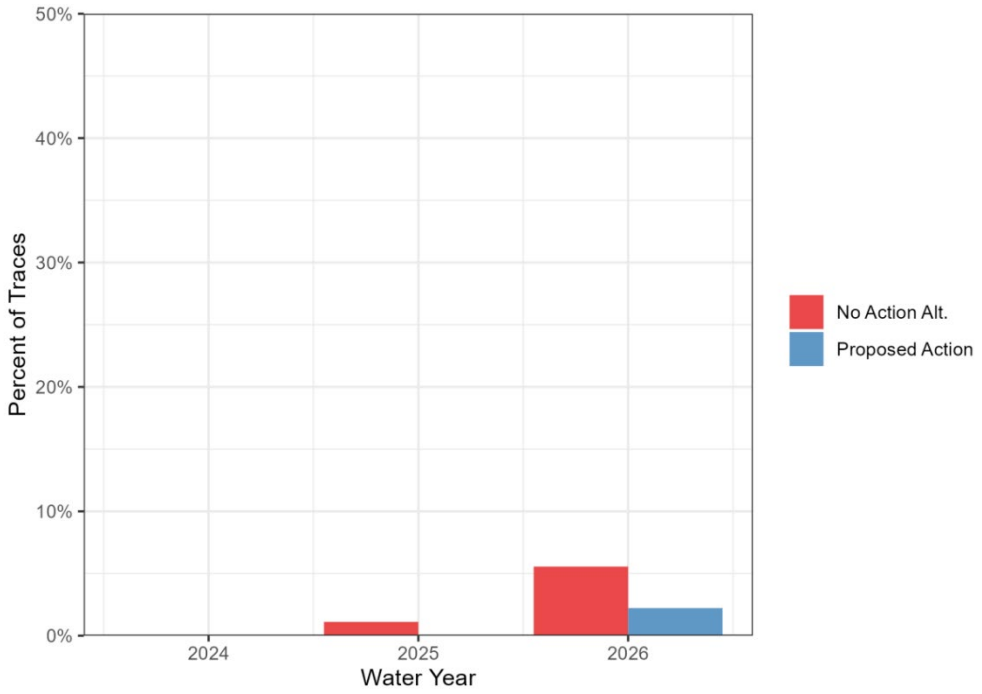
The 10th percentiles of the two alternatives are similar, differing by 0 to 5 feet, which is consistent with the overlap at the low ends of the clouds. The 90th percentiles of the two alternatives are similar, differing by 0 to 6 feet, which is consistent with the overlap at the high ends of the clouds.

Percentages of Traces Below Critical Elevations

Figure 3-6 shows the percentage of modeled traces that fall below Lake Powell's elevation of 3,490 feet (minimum power pool) at any time during an operating year for the period of analysis. Remaining above 3,490 feet is critical for protecting infrastructure and ensuring Glen Canyon Dam continues to operate under its intended design for purposes of downstream water releases.

Figure 3-6 shows that in 2024, no modeled traces fall below a Lake Powell elevation of 3,490 feet under either the No Action Alternative or the Proposed Action. In 2025, only 1.5 percent of the No Action Alternative traces fall below an elevation of 3,490 feet at some point during the water year while none of Proposed Action traces do. In 2026, the No Action Alternative results in 6 percent of traces falling below 3,490 feet, while 2 percent of the Proposed Action's traces do so.

Figure 3-6
Lake Powell Minimum Operating Year Elevation, Percent of Traces Less Than Elevation 3,490 feet



[6] Operating tiers are set on January 1, which is equivalent to midnight on December 31.

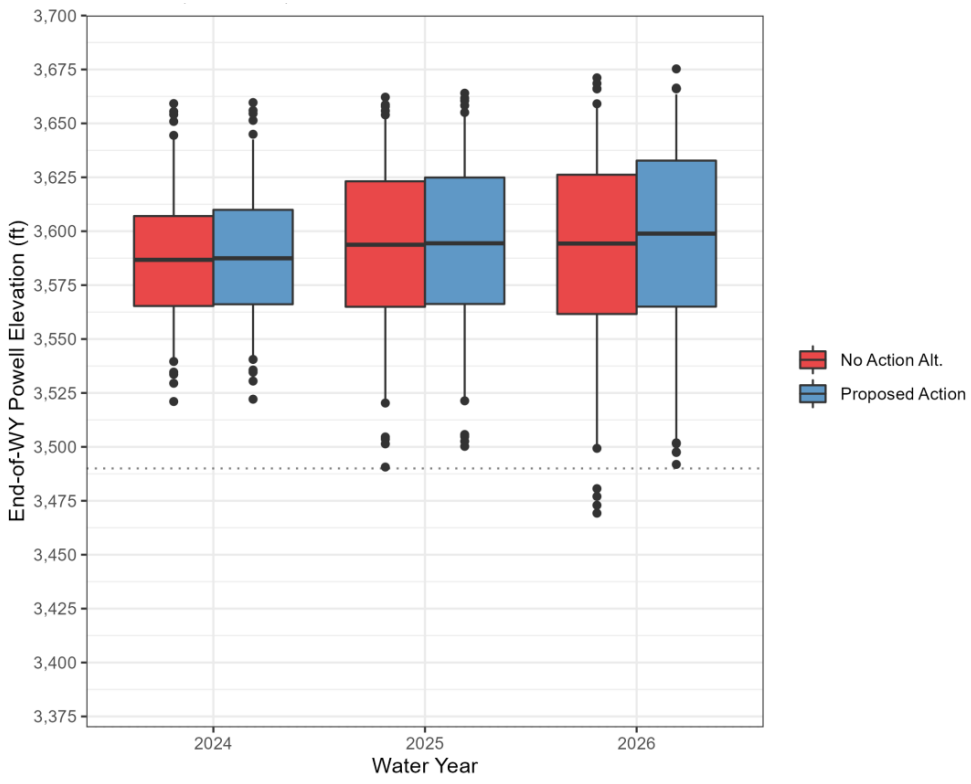
During the period of analysis, neither the No Action Alternative nor the Proposed Action result in pool elevations that approach dead pool (3,370 feet); 100 percent of traces remain above Lake Powell dead pool.

Annual Pool Elevations

Figure 3-7 shows the distributions of modeled Lake Powell elevations at the end of the operating year, on September 30 in 2024, 2025, and 2026. The bold center line of each box represents the median. The top and bottom of each box captures the 25th to 75th percentiles of the modeled elevations, the whiskers extend to the 5th and 95th percentiles, and the outliers are represented as dots beyond these lines.

The No Action Alternative and Proposed Action boxplots in **Figure 3-7** show how the range of modeled end-of-water-year pool elevations at Lake Powell increases over the period of analysis. The median pool elevations of the No Action Alternative increase from 3,587 feet in 2024 to 3,594 feet in 2025, and 3,594 feet in 2026. The range of the interquartile elevations, as well as the whiskers and outliers, for the No Action Alternative becomes wider through time. The interquartile ranges for the No Action Alternative span approximately 42 feet in 2024, 58 feet in 2025, and 65 feet in 2026. The whisker ranges for the No Action alternative span approximately 103 feet in 2024, 132 feet in 2025, and 159 feet in 2026.

Figure 3-7
Powell End-of-Water-Year Pool Elevations



The Proposed Action has median end-of-water-year elevations that are slightly higher than the No Action Alternative by approximately 1 foot in 2024 (3,588 feet), 1 foot in 2025 (3,595 feet), and 5 feet in 2026 (3,599 feet). Like the No Action Alternative, the interquartile and full ranges for the Proposed Action become wider over the period of analysis. The interquartile ranges for the Proposed Action are slightly wider than the No Action Alternative and span a range of approximately 44 feet in 2024, 59 feet in 2025, and 68 feet in 2026. The whiskers for the No Action Alternative and the Proposed Action span approximately the same range; however, the whiskers for the Proposed Action are between 1 and 4 feet higher than the No Action Alternative whiskers. Likewise, the outliers for the Proposed Action are higher in elevation than the No Action Alternative outliers.

Lake Mead

Summary of Alternatives Comparison

The conclusions in this section are drawn from analyses of three metrics: monthly pool elevations, percentages of traces below critical elevations, and annual pool elevations. Detailed comparisons of the alternatives follow in subsequent sections.

With respect to all metrics, the No Action Alternative resulted in lower monthly pool elevations in Lake Mead than the Proposed Action. For 2024–2026, both alternatives have similar seasonal fluctuations and magnitudes of variability, but the distributions of elevations under the Proposed Action are shifted higher than the No Action. The median of the modeled Lake Mead elevations for the No Action Alternative exhibits a downward trend throughout the period of analysis, from 1,056 feet in 2024 to 1,052 feet in 2025, and to 1,049 feet in 2026. Conversely, the median in the Proposed Action results in higher monthly pool elevations than the No Action Alternative and exhibits an upward trend due to projected full implementation of SEIS conservation. The median monthly elevations for the Proposed Action are 1,063 feet in 2024, 1,066 feet in 2025, and 1,067 feet in 2026, which are 7 feet, 15 feet, and 18 feet higher, respectively, than the median monthly elevations for the No Action Alternative.

The percentage of traces in the No Action Alternative falling below the critical elevation in Lake Mead of 1,020 feet was 0 percent in 2024, 7 percent in 2025, and 18 percent in 2026. The percentage of traces in the Proposed Action falling below 1,020 feet was 0 percent in 2024 and 2025, and 4 percent in 2026. The percentage of traces in the No Action Alternative falling below the critical elevation in Lake Mead of 1,000 feet was 0 percent in 2024 and 2025, and 4 percent in 2026. The percentage of traces in the Proposed Action falling below 1,000 feet was 0 percent in 2024 and 2025, and 2 percent in 2026.

Both the No Action Alternative and the Proposed Action result in all traces remaining above the minimum power pool elevation of 950 feet during the period of analysis.

The modeled end-of-calendar-year Lake Mead median pool elevations for the Proposed Action are higher than the No Action Alternative by 11 feet in 2024, 18 feet in 2025, and 20 feet in 2026. The end of year median pool elevations in the Proposed Action trend upward throughout the period of analysis, while the median elevations in the No Action Alternative trend downward. The interquartile ranges for end-of-calendar-year elevations in the No Action Alternative are slightly

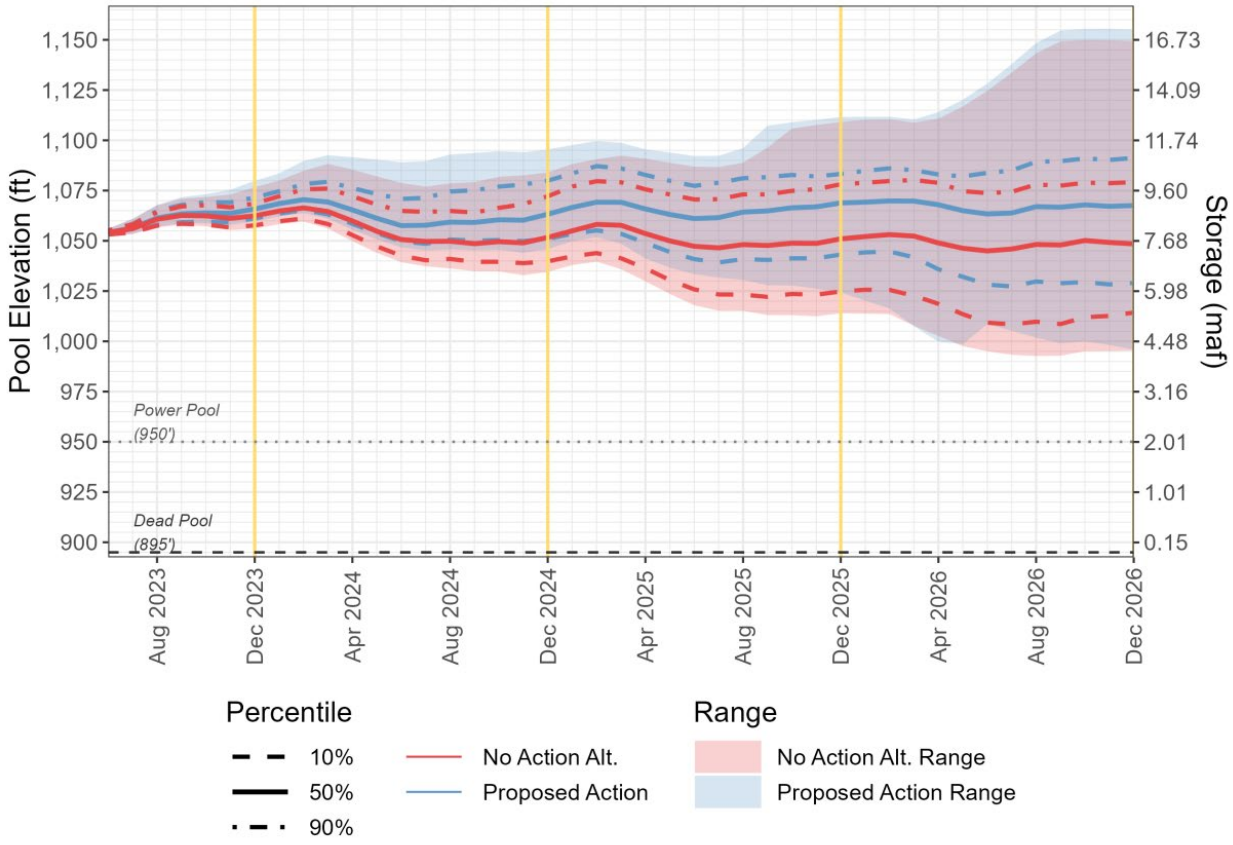
wider than the Proposed Action, indicating results of the No Action Alternative are more uncertain over time. Likewise, the 5th and 95th percentile ranges for end-of-calendar-year elevations in the No Action Alternative are slightly wider than the Proposed Action.

Throughout the period of analysis, the No Action Alternative results in lower median monthly elevations; more traces falling below critical elevations; and lower median end-of-calendar-year elevations than the Proposed Action. The No Action Alternative results in Lake Mead median pool elevations that decrease over the period of analysis. Conversely, the Proposed Action results in Lake Mead median pool elevations that increase due to accumulation of SEIS conservation through 2026.

Monthly Pool Elevations

Figure 3-8 presents a comparison of the 10th, 50th, and 90th percentiles of modeled Lake Mead elevations for both alternatives as dashed, solid, and dash-dotted lines, respectively. It also shows "clouds" representing the full ranges of modeled elevations for both alternatives through 2026.

Figure 3-8
Lake Mead End-of-Month Pool Elevations



The full range of modeled Lake Mead pool elevations resulting from the No Action Alternative is shown by the red cloud in **Figure 3-8**, which spans from 1,033 feet to 1,088 feet in 2024, with fluctuations corresponding to seasonal reservoir levels. The bottom of the No Action Alternative cloud, which results from drier modeled traces, falls to 1,012 feet in 2025 and then to 993 feet in 2026. Even when the bottom of the No Action Alternative cloud reaches an ultimate low of 993 feet in 2026, the pool elevation at Lake Mead remains 43 feet above the minimum power pool elevation of 950 feet and 98 feet above the dead pool elevation of 895 feet. At dead pool, only flows that reach the reservoir, minus any diversions or losses, could be released downstream through the Hoover Dam and water could not be released through the dam via gravity below this elevation. The top of the No Action Alternative cloud, which results from wetter modeled traces, rises to a high of 1,109 feet in 2025 and then to a high of 1,150 feet in 2026. This increasing range in monthly pool elevations is consistent with increasing uncertainty over time.

The clouds for the No Action Alternative (red) and the Proposed Action (blue) have similar fluctuations corresponding to seasonal reservoir levels. Throughout the period of analysis, the range of hydrologic traces (from the driest to the wettest traces) in the No Action Alternative result in lower monthly Lake Mead elevations than the Proposed Action. The cloud of the Proposed Action is consistently higher than the No Action Alternative due to SEIS conservation under the Proposed Action, except for April 2026. To protect 3,500 feet, April 2026 Glen Canyon Dam releases are reduced in the Proposed Action resulting in a lower minimum monthly pool elevation compared to the No Action Alternative. In May 2026, runoff into Lake Powell increases resulting in a higher release from Glen Canyon Dam while maintaining the Lake Powell elevation of 3,500 feet. These operational adjustments result in the different behavior in the minimum pool elevation of the Proposed Action. In 2024, the minimum modeled elevation for the Proposed Action is 1,044 feet, or 11 feet higher than the lowest elevation of the No Action Alternative (1,033 feet) in 2024. The minimum elevation of the Proposed Action in 2025 is 1,024 feet, or 12 feet higher than the No Action Alternative. The minimum elevation of the Proposed Action in 2026 is 996 feet, or 3 feet higher than the No Action Alternative.

In **Figure 3-8**, the median of the modeled Lake Mead elevations for the No Action Alternative ranges between 1,049 feet and 1,066 feet in 2024 and exhibits a downward trend throughout the period of analysis. The median elevation for the No Action Alternative drops to a low of 1,046 feet in 2025 and 1,045 feet in 2026. Due to SEIS conservation, the median monthly pool elevations for the Proposed Action are higher than the No Action Alternative and exhibit an upward trend throughout the period of analysis. The median pool elevations for the Proposed Action are approximately 7 feet higher in 2024, 15 feet higher in 2025, and 18 feet higher in 2026 than the No Action Alternative.

The 10th percentile of modeled Lake Mead elevations in **Figure 3-8** for the Proposed Action are consistently higher than the 10th percentile of the No Action Alternative throughout the period of analysis. The 10th percentiles of the Proposed Action are between 4 feet and 20 feet higher than the No Action Alternative, with the difference between the two alternatives growing larger until August 2026, when the 10th percentiles of the No Action Alternative begin to recover. The 10th percentile of elevations trends downward for both alternatives. The 90th percentiles of the two alternatives are

similar, with the Proposed Action remaining 3 feet to 12 feet higher than the No Action Alternative. The 90th percentile of elevations trends upward for both alternatives.

Percentages of Traces Below Critical Elevations

Figure 3-9 shows the percent of modeled traces that fell below the Lake Mead elevation of 1,020 feet at any time during a year for the period of analysis. The elevation of 1,020 feet was identified as a critical protection elevation in the 2019 DCPs.

Figure 3-9 shows that in 2024, no modeled traces fall below a Lake Mead elevation of 1,020 feet under either the No Action Alternative or the Proposed Action. In 2025, 7 percent of the No Action Alternative traces fall below an elevation of 1,020 feet at some point during the operating year while none of the Proposed Action traces do. In 2026, the No Action Alternative results in 18 percent of traces falling below 1,020 feet, while 4 percent of the Proposed Action's traces do so.

Figure 3-9
Lake Mead Minimum Annual Elevation,
Percent of Traces Less Than Elevation 1,020 feet

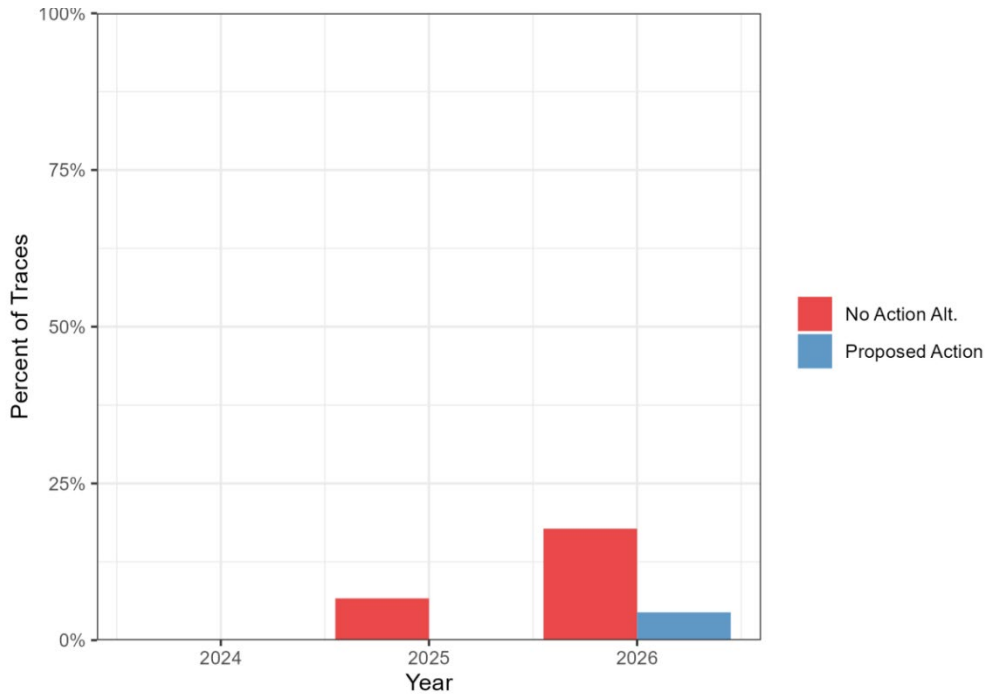
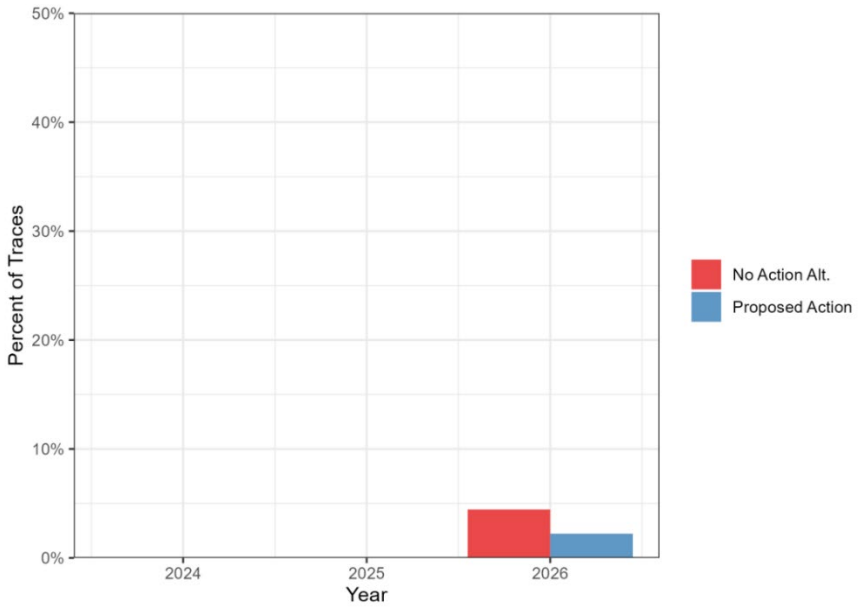


Figure 3-10 shows the percentage of modeled traces that fell below a Lake Mead elevation of 1,000 feet at any time during a year for the period of analysis. Neither the No Action Alternative or the Proposed Action result in any traces falling below 1,000 feet at Lake Mead at any time during 2024 or 2025. In 2026, the No Action Alternative results in 4 percent of traces falling below 1,000 feet, while 2 percent of the Proposed Action's traces do so.

Figure 3-10
Lake Mead Minimum Annual Elevation,
Percent of Traces Less Than Elevation 1,000 feet



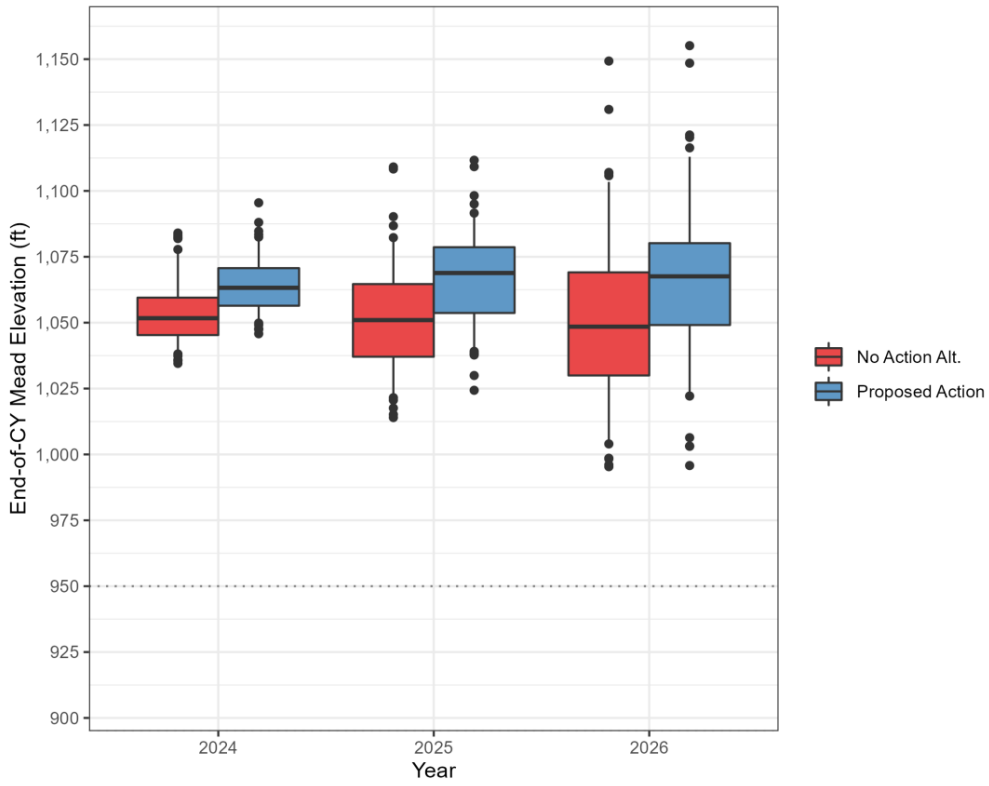
At Lake Mead, an elevation of 950 feet is a critical elevation because it is the lowest elevation at which Hoover Dam can generate hydropower (minimum power pool). No modeled traces in either alternative fell below the Lake Mead elevation of 950 feet at any time during a year for the period of analysis. Therefore, no modeled traces approached an elevation of 895 feet, which is dead pool at Lake Mead.

Annual Pool Elevations

Figure 3-11 shows the distributions of modeled Lake Mead elevations at the end of the calendar year, on December 31 in 2024, 2025, and 2026. This end-of-calendar-year elevation is used to determine shortage conditions for the following operational year. The bold center line of each box represents the median. The top and bottom of each box captures the 25th to 75th percentiles (interquartile range) of the modeled elevations, the whiskers extend to the 5th and 95th percentiles, and the outliers are represented as dots beyond these lines.

The No Action Alternative and Proposed Action boxplots in **Figure 3-11** show how the range of modeled end-of-calendar-year pool elevations at Lake Mead is projected to change over the period of analysis. The median pool elevations of the No Action Alternative decrease from 1,052 feet in 2024 to 1,051 feet in 2025, and to 1,048 feet in 2026. The range of the interquartile elevations, as well as the whiskers and outliers, become wider through time. The interquartile for the No Action Alternative spans a range of approximately 14 feet in 2024, 28 feet in 2025, and 39 feet in 2026. The whisker ranges for the No Action Alternative span approximately 38 feet in 2024, 51 feet in 2025, and 90 feet in 2026.

Figure 3-11
Mead End-of-Calendar-Year Elevation



The Proposed Action has median end-of-calendar-year pool elevations that are higher than the No Action Alternative by approximately 11 feet in 2024 (1,063 feet), 18 feet in 2025 (1,069 feet) and 20 feet in 2026 (1,068 feet). Unlike the No Action Alternative, the Proposed Action results in median pool elevations that increase over the period of analysis. Like the No Action Alternative, the interquartile and full ranges for the Proposed Action become wider over the period of analysis. The interquartile ranges for the Proposed Action are the same or slightly smaller than the No Action Alternative and span approximately 14 feet in 2024, 25 feet in 2025, and 31 feet in 2026. The whisker ranges for the Proposed Action are smaller than the No Action Alternative ranges by approximately 6 feet in 2024 and 9 feet in 2025 and 2026.

While the elevations for Lake Mead are generally higher overall for the Proposed Action due to SEIS conservation, resulting in a stronger protection of critical elevations in Lake Mead, the lower extremes in the No Action Alternative and Proposed Action are essentially the same because of the modification in Glen Canyon Dam operations designed to protect Lake Powell at an elevation of 3,500 feet in the Proposed Action.

Lake Mohave and Lake Havasu

Summary

Lake Mohave and Lake Havasu are operated on a rule curve and have target end-of-month elevations. This manner of operation will continue in the future and would apply to operations

under both alternatives. Therefore, future Lake Mohave and Lake Havasu elevations could be similar between the Proposed Action and No Action Alternative.

Cumulative Effects

The operating tiers established by this SEIS will determine annual release volumes in the LTEMP SEIS. The LTEMP SEIS includes two elements: smallmouth bass flow options and a potential adjustment to HFE sediment account periods and implementation windows. The smallmouth bass flow options would result in temporary changes to daily and hourly flows, which would not impact reservoir levels. Therefore, the potential change of smallmouth bass flow options would result in no changes to annual or monthly reservoir levels in Lake Powell or Lake Mead. The potential adjustment to HFE sediment accounting periods and implementation windows could result in changes in the timing of HFEs, which could minimally affect monthly reservoir levels in Lake Powell and Lake Mead. These differences are expected to be minor, temporary, and resolved by the end of the operating year and would result in no changes to annual reservoir levels in Lake Powell or Lake Mead. Therefore, minimal cumulative effects would occur on reservoir levels due to proposed operational changes evaluated in the LTEMP SEIS.

Lastly, no additive cumulative effects would occur on hydrologic resources due to the proposed management activities planned in the Salton Sea 10-Year Plan or the environmental assessment for the implementation of the 10-Year Plan's projects. No cumulative impacts would result as the Proposed Action is not adding additional impacts to those that are already occurring; however, these impacts might occur sooner under the Proposed Action.

Issue 2: How would changes to operational activities affect reservoir releases?

This section presents a comparison of reservoir release volumes under the No Action Alternative and the Proposed Action in various metrics, including reservoir operating tiers, annual release volumes, and monthly release volumes. All statistics calculated are reflective of the hydrology scenarios and other assumptions used in modeling and are not intended to suggest actual probabilities of any events occurring. However, it is meaningful to compare statistics across alternatives to differentiate performance.

Glen Canyon Dam

Summary of Alternatives Comparison

The conclusions in this section are drawn from analyses in four metrics: Lake Powell Operational Tiers, water year Glen Canyon Dam releases, monthly Glen Canyon Dam releases, and the 10-year running sum of Lees Ferry gaged flows. Detailed comparisons of the alternatives follow in subsequent sections.

Throughout the period of analysis, the No Action Alternative and the Proposed Action result in roughly the same number of traces in each of the Operational Tiers. For both alternatives, more traces shift into higher Operational Tiers in 2025 and 2026. In 2026, 10 percent of traces modeled under both the No Action Alternative and the Proposed Action operate in the Equalization Tier and 51 percent in the Upper Elevation Balancing Tier. This is the result of increasing elevations at Lake Powell.

The Mid-Elevation Release Tier and Lower Elevation Balancing Tier operations are the same for the No Action Alternative and the Proposed Action, with the exception that the Proposed Action allows for reduced releases to 6.0 maf from Glen Canyon Dam if elevations in Lake Powell are projected to drop below 3,500 feet. The percentage of traces in the Mid-Elevation Release Tier under the No Action Alternative is 94 percent in 2024, 39 percent in 2025, and 27 percent in 2026; under the Proposed Action, it is 92 percent in 2024, 40 percent in 2025, and 27 percent in 2026. The percentage of traces in the Lower Elevation Balancing Tier for both alternatives is 0 percent in 2024, 6 percent in 2025, and 12 percent in 2026.

Lake Powell operating year releases from the Glen Canyon Dam are similar for the two alternatives and increase in variability during the period of analysis. In 2024, nearly all modeled releases equaled 7.48 maf under both the No Action Alternative and Proposed Action. In 2025, the total and interquartile ranges increased under both the No Action Alternative and Proposed Action: half and just under half of the releases equal 9.0 maf or more, respectively. In 2026, the range of modeled releases further increases, although the distribution of traces with releases of 9.0 maf or more remains similar to 2025 under both the No Action Alternative and Proposed Action. The Proposed Action results in slightly lower operating year release volumes than the No Action Alternative.

The modeled median monthly Glen Canyon Dam releases under the No Action Alternative are consistently higher than the Proposed Action, although the two alternatives span approximately the same interquartile ranges. Seasonal variations between both alternatives are similar, with a wider variability from April to September due to the potential for both larger or smaller releases due to balancing or equalization, consistent with the LTEMP monthly release pattern. There is the potential for relatively lower releases in the April to September period in the Proposed Action, which allows for a mid-year adjustment to lower releases beginning in April. Throughout the operating year, no traces fall below the estimated daily minimum flow threshold specified by the LTEMP in the Proposed Action and No Action Alternative.

Lake Powell Operating Tiers

Figure 3-12 shows the percentage of modeled traces that were within each Operational Tier for the period of analysis. Under both alternatives, the applicable Operational Tier would continue to be based on the August 24-Month Study projection of the January 1 system storage and reservoir water surface elevations for the following operating year. The Equalization and Upper Elevation Balancing Tiers are the same as under the 2007 Interim Guidelines for both alternatives. The Mid-Elevation Release Tier and Lower Elevation Balancing Tier are the same for the No Action Alternative and the Proposed Action, except that Reclamation may reduce releases in the Proposed Action to a minimum release of 6.0 maf to protect elevation 3,500 feet, subject to LTEMP minimum daily flow thresholds. Refer to **Section 2.6.2** and **Section 2.7.2** for additional details on Operational Tiers for the two alternatives.

Figure 3-12
Lake Powell - Percent of Modeled Traces Within Each Operational Tier

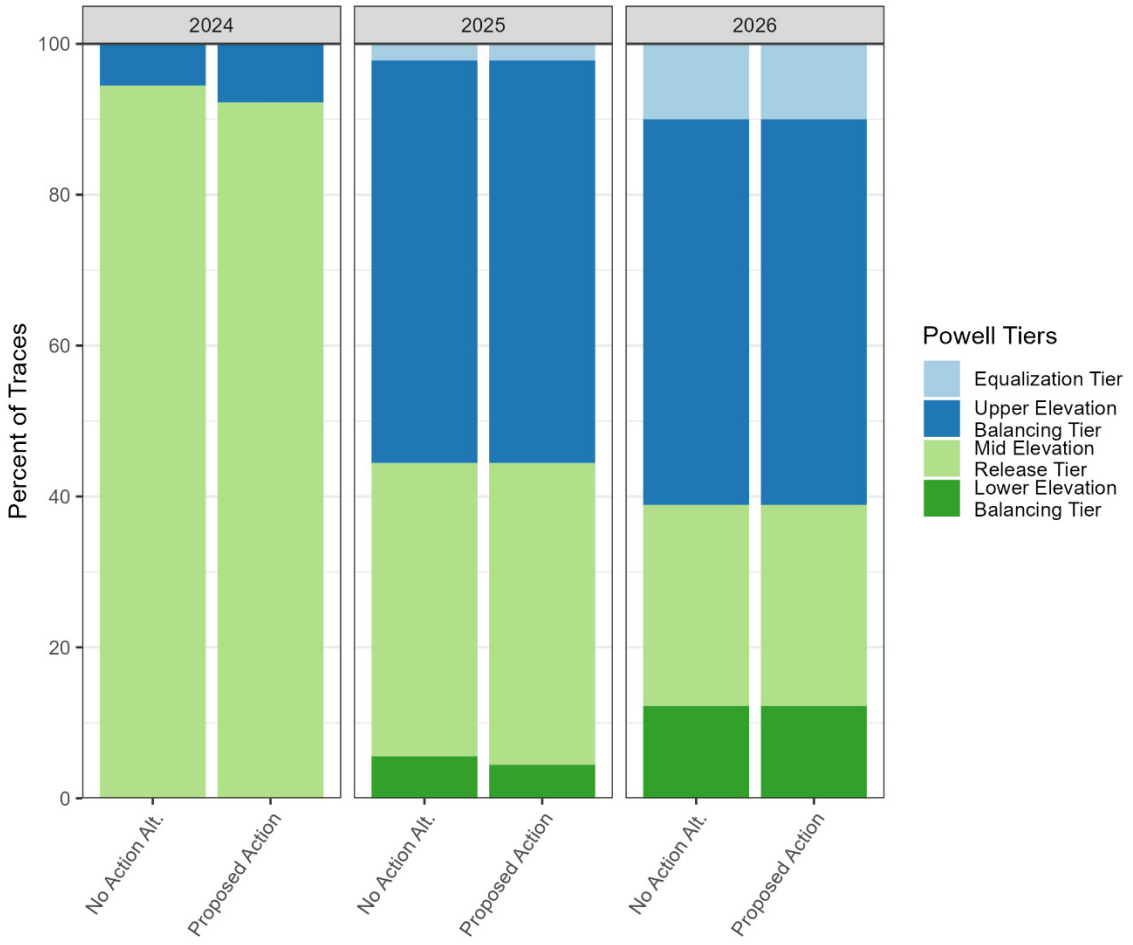


Figure 3-12 shows that in 2024, under both the No Action Alternative and the Proposed Action, no modeled traces are in the Equalization Tier. In 2025, under both the No Action Alternative and the Proposed Action, the percentage of traces in the Equalization Tier increases to 2 percent and then to 10 percent in 2026. Under the No Action Alternative, 6 percent of modeled traces operated in the Upper Elevation Balancing Tier in 2024, in which annual releases range from 7.0 maf to 9.0 maf, and the number of traces in this tier increases to 53 percent in 2025 and then decreases slightly to 51 percent in 2026. Similarly, under the Proposed Action, the percentage of traces that operated in the Upper Elevation Balancing Tier was 8 percent in 2024, 53 percent in 2025, and 51 percent in 2026.

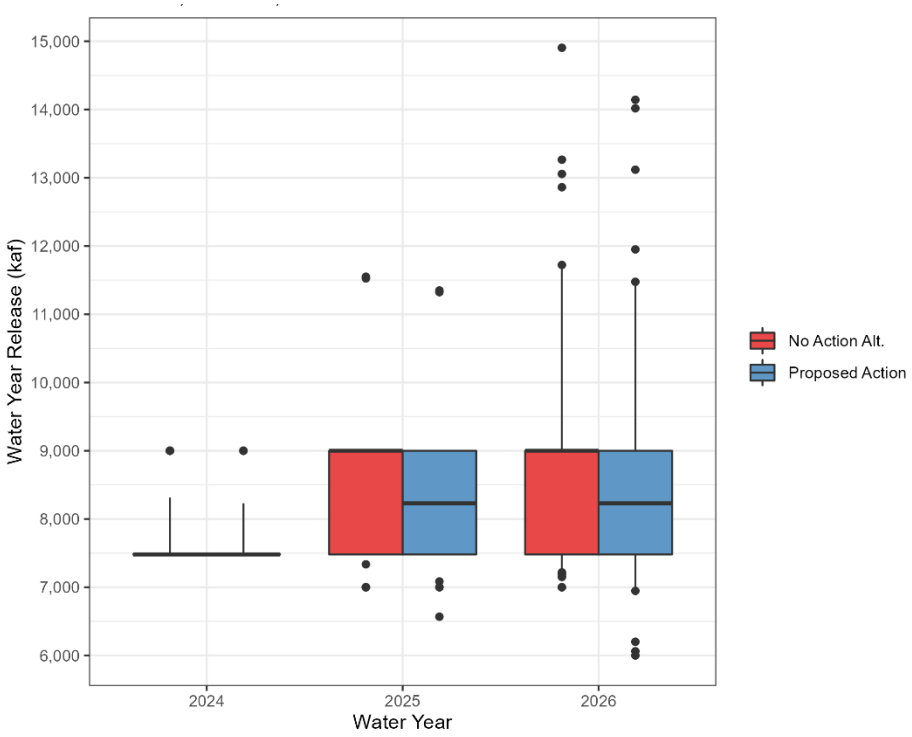
For the No Action Alternative, the percentage of traces in the Mid-Elevation Release Tier—in which the release is either 7.48 or 8.23 maf, depending on the elevation of Lake Mead—are approximately 94 percent in 2024, 39 percent in 2025, and 27 percent in 2026. For the No Action Alternative, the percentage of traces in the Lower Elevation Balancing Tier, in which releases range from 7.0 maf to 9.5 maf, increases from 0 percent in 2024 to 6 percent in 2025, and then to 12 percent by 2026. This shift toward higher tiers is a result of the wide range of hydrology traces, and is reflected in the elevations seen previously in **Figure 3-5**.

If Lake Powell is operating in the Mid-Elevation Release Tier or Lower Elevation Balancing Tier under the Proposed Action, releases are consistent with the No Action Alternative except a mid-year adjustment can reduce releases to a minimum of 6.0 maf to protect 3,500 feet. The percentage of traces that are in the Mid-Elevation Release Tier under the Proposed Action are similar to the No Action Alternative, with 94 percent of traces in 2024, 40 percent in 2025, and 27 percent in 2026. The percentage of traces under the Proposed Action that are in the Lower Elevation Balancing Tier are similar to the No Action Alternative, with 0 percent of traces in 2024, 4 percent in 2025, and 12 percent in 2026.

Annual Release Volumes

Figure 3-13 shows the distributions of modeled water year (October through September) release volumes from Glen Canyon Dam in 2024, 2025, and 2026. This volume is determined by the operating tiers, which were analyzed in the previous section. The bold center line of each box represents the median. The top and bottom of each box captures the 25th to 75th percentiles of the modeled releases, the whiskers extend to the 5th and 95th percentiles, and the outliers are represented as dots beyond these lines.

Figure 3-13
Glen Canyon Dam Water Year Release



The boxplots for the No Action Alternative in **Figure 3-13** show that in 2024, the modeled releases from Glen Canyon Dam were either 7.48 maf or 9.0 maf. Approximately 94 percent of the 2024 No Action Alternative releases were 7.48 maf, corresponding with the Mid-Elevation Release Tier described above. The remaining 6 percent of releases were 9.0 maf, corresponding with the Upper

Elevation Balancing Tier, and were the result of wetter hydrology traces. In 2025 and 2026, median modeled releases from Glen Canyon Dam under the No Action Alternative were 9.0 maf and represent 51 percent of traces in 2025 and 47 percent of traces in 2026. The minimum releases in 2025 and 2026 were 7.0 maf and represent 3 percent and 2 percent of traces, respectively.

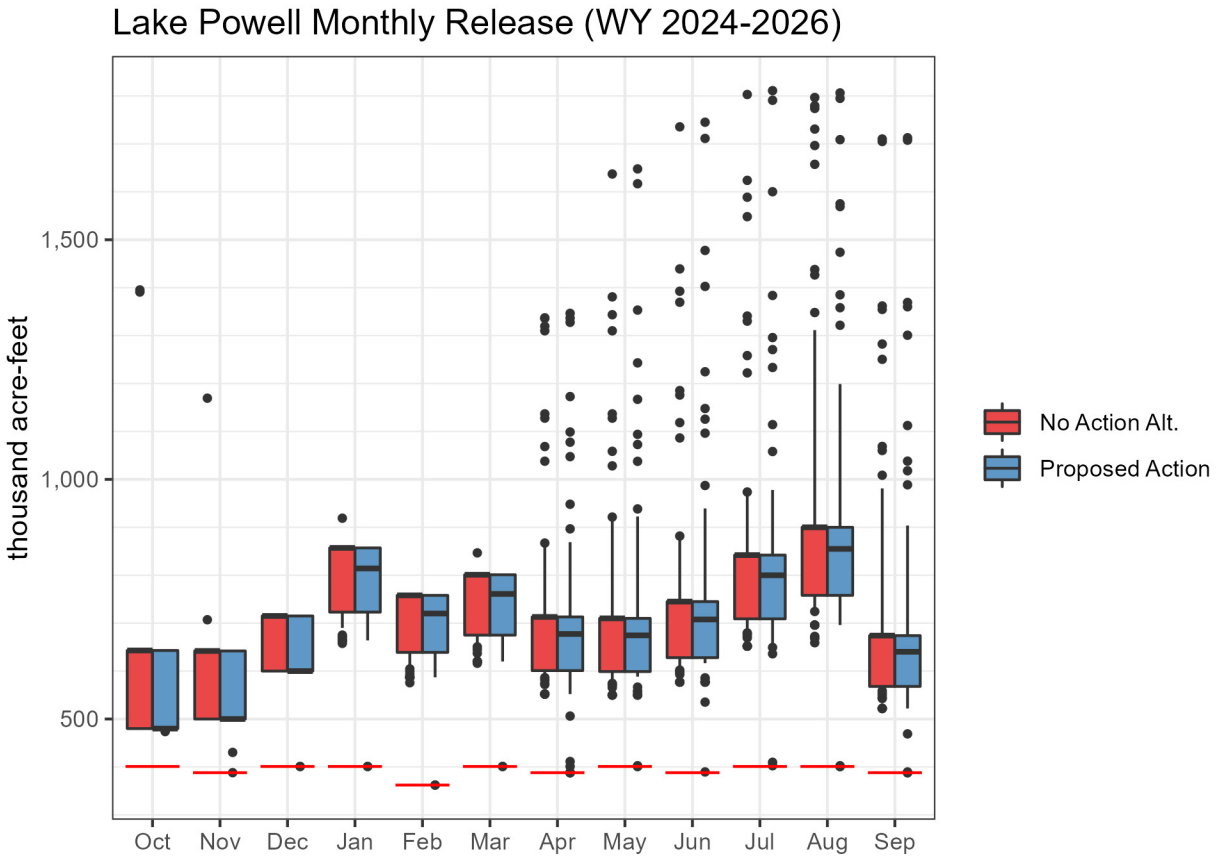
In 2024, the modeled operating year releases for the Proposed Action, as shown in **Figure 3-13**, are similar to the No Action Alternative. Approximately 92 percent of Glen Canyon Dam releases in 2024 were 7.48 maf, 4 percent were 8.23 maf, and 3 percent were 9.0 maf. These releases correspond to the Mid-Elevation Release Tier or the Upper Elevation Balancing Tier. In 2025 and 2026, median modeled releases from Glen Canyon Dam under the Proposed Action were 8.23 maf but represent only 8 percent and 14 percent of modeled traces, respectively. The median release is lower in the Proposed Action compared to the No Action Alternative because Lake Mead has higher pool elevations which results in lower balancing and equalization releases from Glen Canyon Dam. In 2025 under the Proposed Action, approximately 44 percent of releases are less than or equal to 7.48 maf, and 41 percent of releases were greater than or equal to 9.0 maf. In 2026 under the Proposed Action, approximately 39 percent of releases are equal to or less than 7.48 maf and 38 percent were equal to or greater than 9.0 maf.

Monthly Release Volumes

Figure 3-14 shows the distributions of modeled monthly release volumes in operating years 2024, 2025, and 2026, oriented to the water year (October through September) on which Lake Powell operates. The bold center line of each box represents the median. The top and bottom of each box captures the 25th to 75th percentiles of the modeled releases and the whiskers extend to the 5th and 95th percentiles, with outliers represented as dots beyond these lines. The red lines reflect the estimated total monthly volume that would be released if Glen Canyon Dam met the minimum daily releases specified in the LTEMP (5,000 cfs between 7 p.m. and 7 a.m. and 8,000 cfs between 7 a.m. and 7 p.m., with ramping constraints resulting in an estimated average daily flow of 6,521 cfs). These volumes are estimates of how the annual volumes described in the previous section would be divided in consideration of authorities affecting sub-annual releases (hourly, daily, monthly, and experimental releases) from Glen Canyon Dam. See **Section 3.3.4** for more information about these modeling assumptions.

The boxplots of monthly modeled Glen Canyon Dam release volumes under the Proposed Action in **Figure 3-14** demonstrate the impacts of the annual minimum release of 6.0 maf to protect the Lake Powell elevation of 3,500 feet with a minimum release defined by LTEMP, as outlined in the Proposed Action for the Mid-Elevation Release Tier and Lower Elevation Balancing Tier. For both the No Action Alternative and the Proposed Action, the range of interquartile values are approximately the same. The difference between the 75th and 25th interquartile values for both alternatives range from a high of approximately 163 kaf in October (at the beginning of the operating year) down to approximately 111 to 126 kaf in December through June. The interquartile ranges for July and August are around 133 kaf and 142 kaf, respectively. The wide variability from April to September is mostly due to years that have an April switch to balancing or equalization. (when starting the year with an 8.23 maf release in the Upper Elevation Balancing Tier).

Figure 3-14
Lake Powell Monthly Release, Water Years 2024–2026



Red lines reflect an estimated monthly volume based on the minimum daily release from LTEMP (5,000 cfs between 7 p.m. and 7 a.m. and 8,000 cfs between 7 a.m. and 7 p.m., with ramping constraints resulting in an estimated average daily flow of 6.521 cfs).

The monthly releases on the lower end of the distributions under the Proposed Action tend to be lower or substantially lower than those under the No Action Alternative in **Figure 3-14**. The 6.0 maf minimum operating year release in the Proposed Action causes the differences in minimum releases between the two alternatives. The minimum monthly release in the Proposed Action is the result of reduced monthly releases to protect 3,500 feet. Instances where the minimum monthly release is equal to the LTEMP minimum release (i.e., outliers on the red line) correspond to months when Lake Powell is at or below 3,500 feet and releases cannot be reduced further. No traces under the No Action Alternative or the Proposed Action are lower than the estimated daily minimum LTEMP flows. **Table 3-5** illustrates an example of the monthly release volumes for the 6.0-maf minimum operating year release under the Proposed Action. This table serves as an example for the potential monthly patterns in the event of minimum operating year releases.

Table 3-5
Monthly Release Volumes under LTEMP with Example Release Pattern for 6.0 maf

Monthly Release Volume (thousand acre-ft)					
Month	**6,000**	**7,000**	**7,480**	**8,230**	**9,000**
October	411	480	480	643	643
November	429	500	500	642	642
December	514	600	600	715	715
January	569	664	723	763	857
February	503	587	639	675	758
March	531	620	675	713	801
April	473	552	601	635	713
May	471	550	599	632	710
June	495	577	628	663	745
July	559	652	709	749	842
August	597	696	758	800	900
September	447	522	568	600	674

Figure 3-14 shows that the No Action Alternative median monthly release is consistently higher than the Proposed Action, consistent with results for operating year releases in **Figure 3-13**. The largest difference between the median monthly releases for the No Action Alternative and the Proposed Action occurs during the beginning of the operating year from October through December.

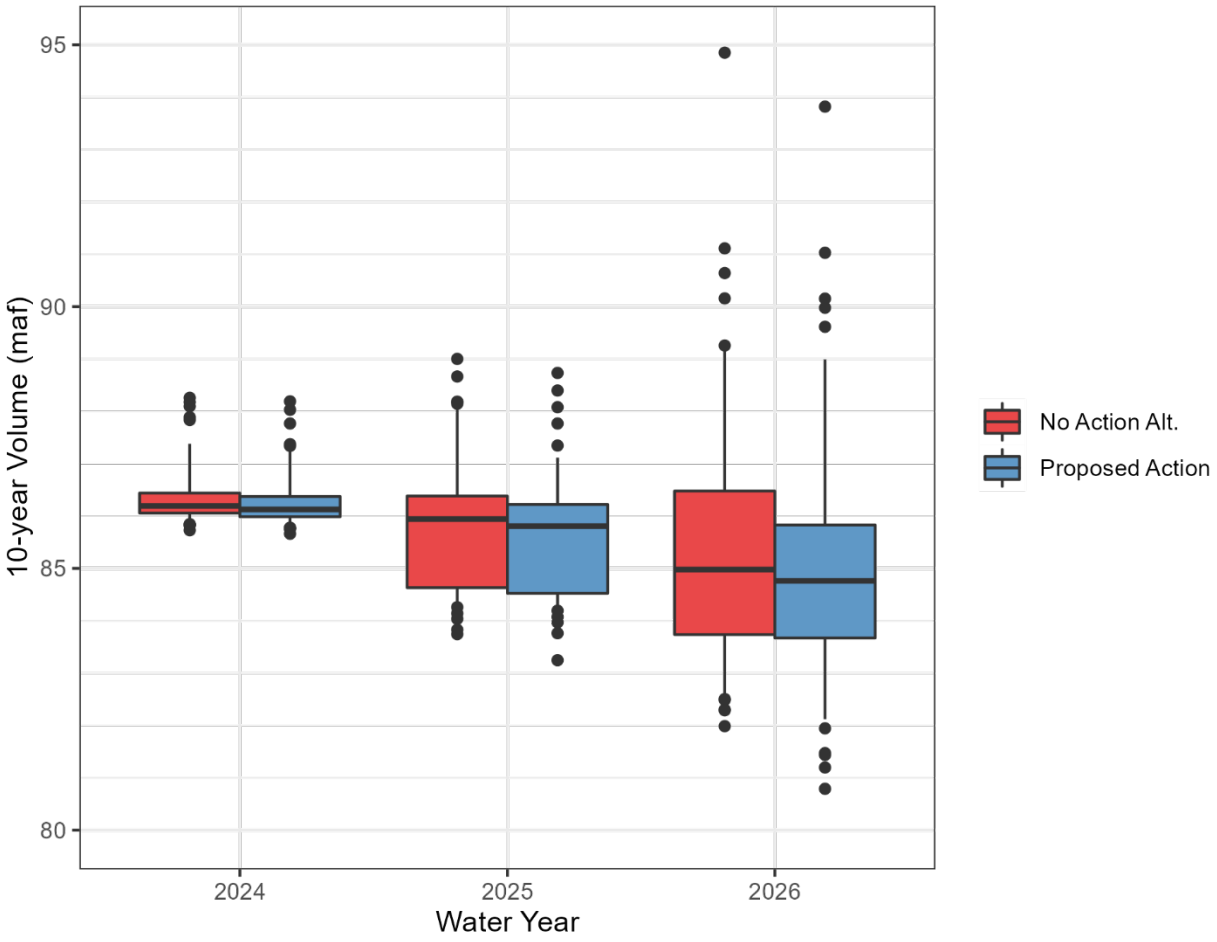
Ten-Year Lees Ferry Gage Flows

Figure 3-15 shows the distribution of modeled 10-year running sums of Lees Ferry gage flows in 2024, 2025, and 2026. The modeled 2024 flow is calculated using the observed flow from October 2014 through May 2023 and a modeled flow from June 2023 through September 2024. There is some variability in the 2023 volume, but it is common to both alternatives so it does not impact relative performance among alternatives. The modeled 2025 volume drops the 2015 observed operating year volume, and the modeled 2026 volume drops 2015 and 2016 to maintain the ten-year period.

In the figure below, the bold center line of each box represents the median. The top and bottom of each box captures the 25th to 75th percentiles of the modeled volumes, the whiskers extend to the 5th and 95th percentiles, and the outliers are represented as dots beyond these lines.

The distributions of modeled 10-year running sums in **Figure 3-15** show that the median volumes decline over time for both alternatives, although the median flows of the Proposed Action are always lower than the medians of the No Acton Alternative. The interquartile and full ranges increase, with the ranges of the Proposed Action increasing more toward the lower end, compared with the No Action Alternative. In 2024, the median flow volumes under the No Action Alternative and Proposed Action are just over 87 maf. Median flow volumes decrease in 2025 to 86 maf under the No Action Alternative and just below 86 maf under the Proposed Action. In 2026, the median of the No Action Alternative is approximately 85 maf, while the median under the Proposed Action

Figure 3-15
Lees Ferry Gage 10-Year Running Total



is just over 84 maf. Under the No Action Alternative in 2026, 5 percent of modeled 10-year Lees Ferry gage flows are below 82.3 maf, while slightly over 5 percent of modeled traces are below 82.3 maf under the Proposed Action. Neither alternative has any traces with the modeled 10-year running sum of flows at Lees Ferry below 75 maf.

Hoover Dam

Summary of Alternatives Comparison

The conclusions in this section are drawn from analyses of operating year releases from Lake Mead at the Hoover Dam. Detailed comparisons of both alternatives follow in subsequent sections.

Under the No Action Alternative, the median modeled annual release from Hoover Dam increases from 8.51 maf in 2024 to 8.65 maf in 2025, and to 8.77 maf in 2026. The ranges around these medians for each year are relatively consistent and increase over the period of analysis.

Under the Proposed Action, the median modeled annual releases from Hoover Dam increase from 7.94 maf in 2024 to 8.08 maf in 2025, and to 8.37 maf in 2026. These median annual releases are

between 0.40 maf and 0.57 maf lower than the No Action Alternative. These lower median annual release volumes under the Proposed Action result in better protecting critical elevations in Lake Mead and contribute to increasing pool elevations over the period of analysis, whereas the No Action Alternative results in pool elevations that decrease over the period of analysis. The releases from Hoover Dam are based on downstream demands, which are lower in the Proposed Action due to the additional SEIS conservation.

Annual Release Volumes

Figure 3-16 shows the distributions of modeled calendar year release volumes from Hoover Dam in 2024, 2025, and 2026. The bold center line of each box represents the median. The top and bottom of each box captures the 25th to 75th percentiles of the modeled releases, the whiskers extend to the 5th and 95th percentiles, and the outliers are represented as dots beyond these lines.

Figure 3-16
Hoover Dam Calendar Year Annual Release

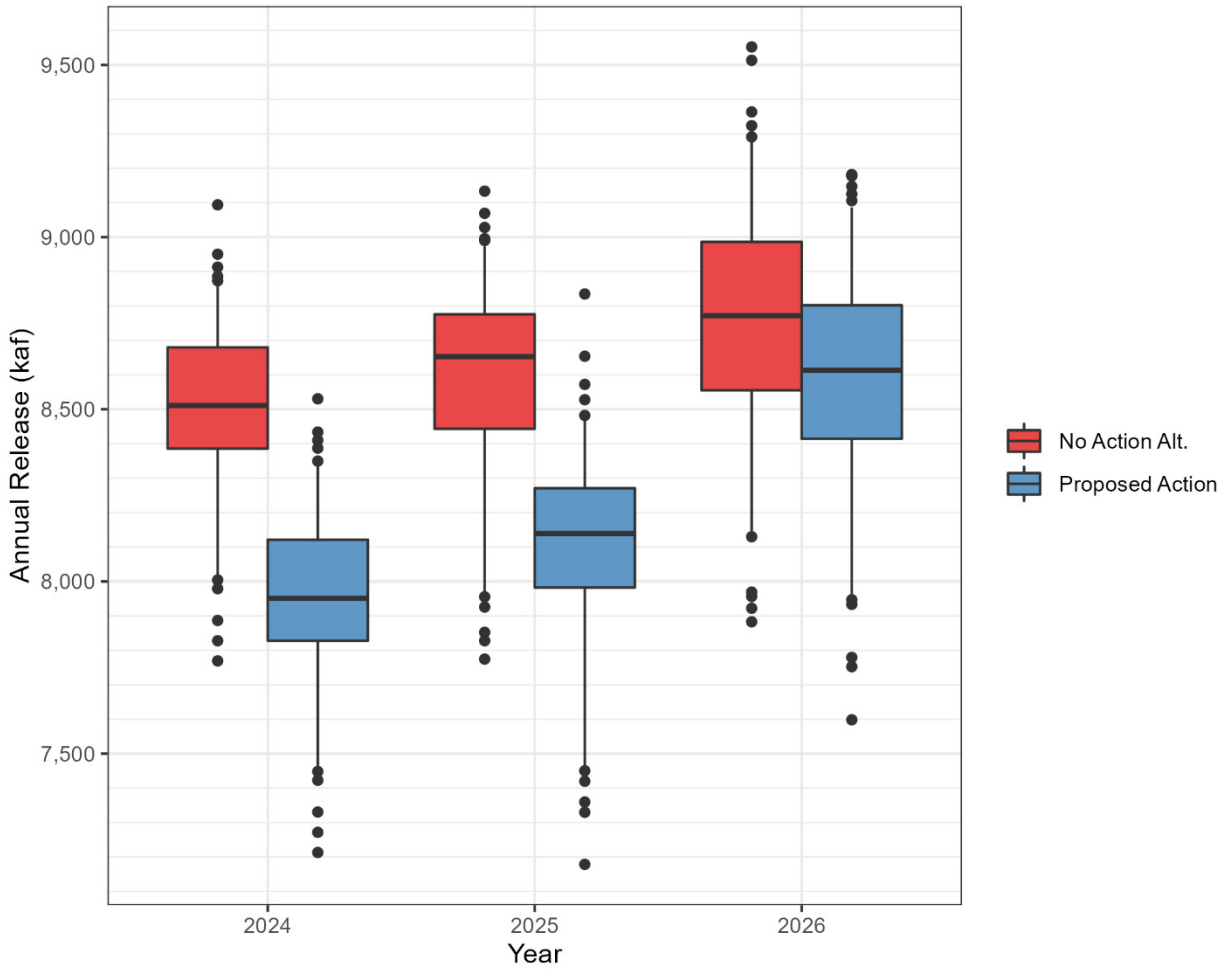


Figure 3-16 shows that under the No Action Alternative, the overall distribution of calendar year releases from Hoover Dam increase over the period of analysis, where the median releases are 8.51 maf in 2024, 8.65 maf in 2025, and 8.77 maf in 2026. The 25th and 75th percentiles increase over

time for the No Action Alternative. The interquartile range of the No Action Alternative also increases over time, beginning with a range of 0.29 maf in 2024 to 0.43 maf in 2026. Likewise, the range of 95th and 5th percentiles increase over the period of analysis. The lowest 5th percentile value for the No Action Alternative is 8.0 maf in 2024 and 2025, and the highest 95th percentile value is 9.3 maf in 2026.

Under the Proposed Action, the overall distribution of modeled calendar year releases from Hoover Dam increases over the period of analysis but remains below the modeled release volumes in the No Action Alternative. The median releases for the Proposed Action are 7.94 maf in 2024, 8.08 maf in 2025, and 8.37 maf in 2026, which are 0.57 maf lower than the No Action Alternative releases in 2024 and 2025, and 0.4 maf lower in 2026. The median releases for the Proposed Action increases more than the No Action Alternative because of higher annual depletions in the earlier parts of the analysis period.

The interquartile variability of the Proposed Action varies, from a range of 0.26 maf in 2024 to 0.19 maf in 2025, and to 0.32 maf in 2026. Likewise, the range of 95th and 5th percentiles for the Proposed Action also vary over time, while the values for the 95th and 5th percentiles increase over time.

Under the two alternatives, **Figure 3-16** shows that the median calendar year releases increase over time. The median releases for the No Action Alternative are between 0.40 maf and 0.57 maf higher than the Proposed Action. However, the ranges and variability for the two alternatives are similar throughout the period of analysis. Lower releases from Hoover Dam under the Proposed Action, due to increased SEIS conservation in the Proposed Action, results in better protecting critical elevations at Lake Mead.

Davis Dam

Summary

The conclusions in this section are drawn from analyses of operating year releases from Davis Dam. Detailed comparisons of the alternatives follow in subsequent sections.

Modeled annual releases from Davis Dam under the No Action Alternative increase slightly in the medians from 8.2 maf in 2024 to 8.4 maf in 2026. The variability around these medians is also consistent. The median annual releases from Davis Dam under the Proposed Action are lower but with a similar range as the No Action Alternative. In 2024, 2025, and 2026, the medians are approximately 7.6, 7.8, and 8.3 maf, respectively. Increased SEIS conservation in 2024 and 2025 lead to increased 2026 elevations in Lake Mead and, therefore, increased releases from Hoover Dam relative to 2025.

Annual Release Volumes

Figure 3-17 shows the distributions of modeled operating year release volumes from Davis Dam in 2024, 2025, and 2026. The bold center line of each box represents the median. The boxes capture the 25th to 75th percentiles of the modeled releases and the whiskers extend to the 5th and 95th percentiles, with outliers represented as dots beyond these lines.

Figure 3-17
Davis Dam Annual Release

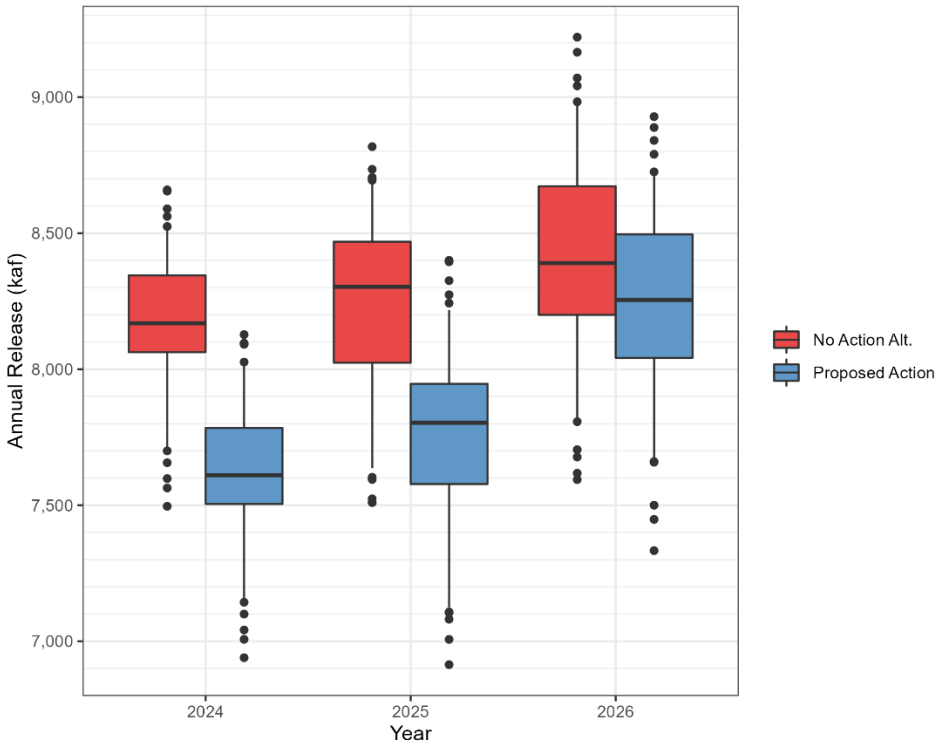


Figure 3-17 shows that under both alternatives, the distributions of modeled annual releases from Davis Dam follow the same pattern as the releases from Hoover Dam; this is because Hoover Dam releases are impounded in Lake Mohave and released from Davis Dam to generate hydropower. The median releases from Davis Dam under the No Action Alternative are 8.2, 8.3, and 8.4 maf in 2024, 2025, and 2026, respectively. The ranges increase each year, with the largest range seen in 2026. The median releases from Davis Dam under the Proposed Action are approximately 7.6, 7.8, and 8.3 maf in 2024, 2025, and 2026, respectively. The ranges in all years under the Proposed Action are similar to the ranges under the No Action Alternative.

Parker Dam

Summary

The conclusions in this section are drawn from analyses of operating year releases from Parker Dam. Detailed comparisons of the alternatives follow in subsequent sections.

Over the period of analysis, the No Action Alternative results in minimal variation in the median modeled annual release from Parker Dam of approximately 6.4 to 6.5 maf because the majority of the shortages and modeled system conservation in the No Action Alternative occur at or above Parker Dam. In 2026, the minimum Parker Dam release under the No Action Alternative is 6.1 maf.

The medians and ranges of modeled annual releases from Parker Dam are lower under the Proposed Action than the No Action Alternative, because there is additional SEIS conservation modeled

below Parker Dam. The median annual releases under the Proposed Action are approximately 6.1 maf in 2024 and 2025, and a range commensurate with the differences in median to the No Action Alternative. The minimum releases in 2026 are slightly higher at 6.3 maf.

Annual Release Volumes

Figure 3-18 shows the distributions of modeled operating year release volumes from Parker Dam in 2024, 2025, and 2026. The bold center line of each box represents the median. The boxes capture the 25th to 75th percentiles of the modeled releases and the whiskers extend to the 5th and 95th percentiles, with outliers represented as dots beyond these lines.

Figure 3-18
Parker Dam Annual Release

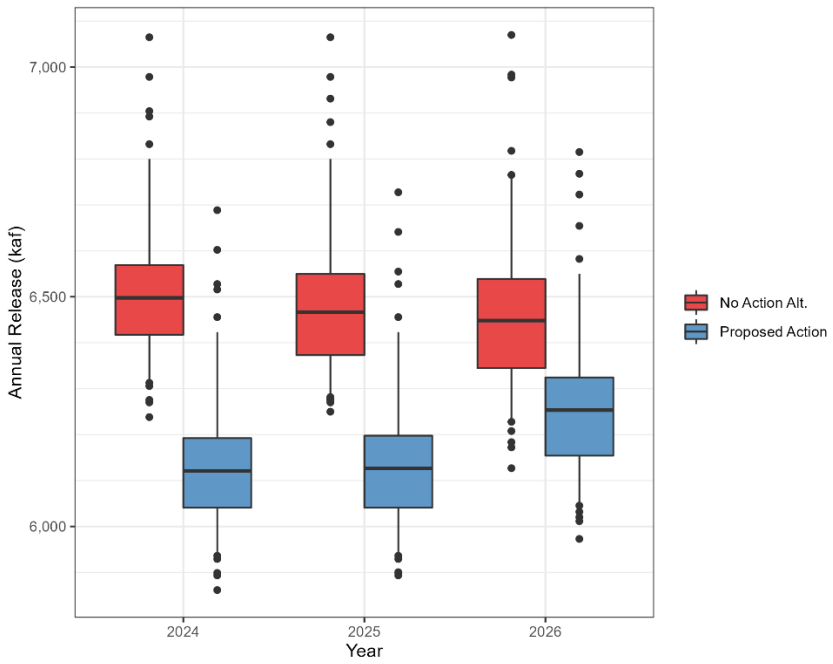


Figure 3-18 shows that under the No Action Alternative, modeled annual releases from Parker Dam decrease slightly across the medians, from 6.5 maf to 6.4 maf, while the ranges are similar through 2025. This is because most of the shortages and modeled system conservation in the No Action Alternative occur at or above Parker Dam. In 2026, the lowest modeled releases decrease from 6.2 maf to 6.1 maf.

The medians of modeled annual releases from Parker Dam are lower under the Proposed Action because there is additional SEIS conservation modeled below Parker Dam. In 2024 and 2025, the median releases under the Proposed Action are 6.1 maf, and 6.3 maf in 2026. The ranges for each year under the Proposed Action vary similarly to the medians.

Cumulative Effects

The operating tiers established by this SEIS will determine annual release volumes in the LTEMP SEIS. The LTEMP SEIS includes two elements: smallmouth bass flow options and a potential

adjustment to HFE sediment account periods and implementation windows. The smallmouth bass flow options would result in temporary changes to daily and hourly flows, which would not impact reservoir levels. Therefore, the potential change of smallmouth bass flow options would result in no changes to annual or monthly reservoir levels in Lake Powell or Lake Mead. The potential adjustment to HFE sediment accounting periods and implementation windows could result in changes in the timing of HFEs, which could minimally affect monthly reservoir levels in Lake Powell and Lake Mead. These differences are expected to be minor, temporary, and resolved by the end of the operating year and would result in no changes to annual reservoir levels in Lake Powell or Lake Mead. Therefore, minimal cumulative effects would occur on reservoir releases due to proposed operational changes evaluated in the LTEMP SEIS.

Lastly, no additive cumulative effects would occur on hydrologic resources due to the proposed management activities planned in the Salton Sea 10-Year Plan or the environmental assessment for the implementation of the 10-Year Plan's projects. No cumulative impacts would result as the Proposed Action is not adding additional impacts to those that are already occurring; however, these impacts might occur sooner under the Proposed Action.

Issue 3: How would changes to operational activities affect river flows?

This section presents a comparison of river flows under the No Action Alternative and the Proposed Action with various metrics, including annual, monthly, and daily release volumes. Because in most cases the river flows in each reach are mainly comprised of upstream reservoir releases, most of the discussion below will refer to figures in *Issue 2*, above.

Glen Canyon Dam to Lake Mead

Summary of Alternatives Comparison

As described in the 2007 FEIS, the river flows that occur between Glen Canyon Dam and Lake Mead result primarily from controlled releases from Glen Canyon Dam (Lake Powell). The gains from tributaries in this reach on average are less than 3 percent of the total flow, are concentrated over short periods of time, and would not be affected by the alternatives. However, future annual and monthly distribution of releases from Glen Canyon Dam may be affected by the alternatives. (See *Issue 2* for additional discussion.)

With respect to annual flows, **Figure 3-13** shows modeled distributions of operating year releases from Glen Canyon Dam for the period of analysis. In general, both the No Action Alternative and the Proposed Action result in similar distributions of releases. The Proposed Action results in lower median operating year releases in 2025 and 2026 due to lower balancing and equalization releases due to the higher pool elevation at Lake Mead. The minimum operating year releases are slightly lower in the Proposed Action than the No Action Alternative, because the Proposed Action allows releases below 7.0 maf to protect elevation 3,500 feet at Lake Powell. (See *Issue 2* for additional discussion.)

Distributions of modeled monthly flows between Glen Canyon Dam and Lake Mead for both the No Action Alternative and the Proposed Action are presented in **Figure 3-14**. The range of interquartile monthly release values for both alternatives are approximately the same, however, the No Action Alternative median monthly release is consistently higher than the Proposed Action. This

is a function of lower balancing and equalization releases in the Proposed Action from Lake Powell resulting from the higher pool elevation at Lake Mead. Both alternatives have lower releases in October through March, with less variability. From April through September, the releases increase, along with the variability. (See *Issue 2* for additional discussion.)

Throughout the operating year, no traces under the No Action Alternative or the Proposed Action are lower than the estimated daily minimum LTEMP flows. Daily flows were not estimated for this SEIS. However, a table of estimates is in Section 4.3.3.1 of the 2007 FEIS. **Figure 3-14** shows how monthly releases from Glen Canyon Dam compare to an estimate of how daily minimum flows specified by the LTEMP would sum to a monthly volume. **Section 3.8** of this SEIS addresses the effects of HFEs and monthly volume releases in the Grand Canyon. The timing of releases is addressed in conjunction with other resources, such as sedimentation.

Hoover Dam to Davis Dam

Summary of Alternatives Comparison

As described in the 2007 FEIS, the river flows between Hoover Dam and Lake Mohave are comprised mainly of releases from Hoover Dam (Lake Mead) and tributary inflows. These tributary inflows, mostly from side washes, comprise less than 1 percent of the total annual flow in this reach. Future annual and monthly releases may be affected by the alternatives. However, due to the presence of Lake Mohave immediately downstream of Hoover Dam, Lake Mohave is the tailwater of Hoover Dam, and acts more as reservoir flows rather than riverine flows. Regardless, these potential changes in releases will only have an effect on hydropower generation.

Distributions of modeled annual releases from Hoover Dam are shown in **Figure 3-16**. Both the No Action Alternative and the Proposed Action result in increasing median annual releases from Hoover Dam over the period of analysis. However, the annual releases from Hoover Dam under the Proposed Action are significantly lower than releases under the No Action Alternative (by 0.40 maf to 0.57 maf). The No Action Alternative and the Proposed Action also exhibit similar variability between the range of modeled annual releases. The minimum annual releases under both alternatives occur in 2024 at 7.94 maf for the Proposed Action and 8.51 maf for the No Action Alternative. (See *Issue 2* for additional discussion.) With lower modeled annual releases from Hoover Dam in the Proposed Action, compared with the No Action Alternative, it is expected that monthly releases and river flows also would be lower.

Davis Dam to Parker Dam

Summary of Alternatives Comparison

River flows between Davis Dam and Parker Dam are mostly comprised of releases from Davis Dam and tributary inflow from the Bill Williams River. Releases from Davis Dam are the variable that would differ between alternatives, so they are used for comparison. Distributions of modeled annual releases from Davis Dam are shown in **Figure 3-17**. In general, the Proposed Action results in lower median annual releases but a similar range, compared with releases under the No Action Alternative. The minimum annual releases under both the No Action and Proposed Action occur in 2025 and 2026 at 7.5 and 6.9 maf, respectively. (See *Issue 2* for additional discussion.) With lower

annual releases from Davis Dam in the Proposed Action, compared with the No Action Alternative, it is expected that monthly releases and river flows would also be lower.

With respect to annual flows near Lake Havasu National Wildlife Refuge (NWR), these river flows show the same general patterns that were observed in the distributions of modeled annual releases from Hoover Dam and Davis Dam since those dams are operated, except during flood control operations, to meet downstream demands. The differences in magnitudes between the releases from Hoover Dam, releases from Davis Dam, and flows near Havasu NWR are due to evaporation loss at Lake Mohave (which would be the same in all alternatives due to rule curve operations) and the relatively small diversions along this stretch of the river. (For more information about ecological impacts, see **Section 3.13** of this SEIS.)

Parker Dam to Cibola Gage and Cibola Gage to Imperial Dam

Summary of Alternatives Comparison

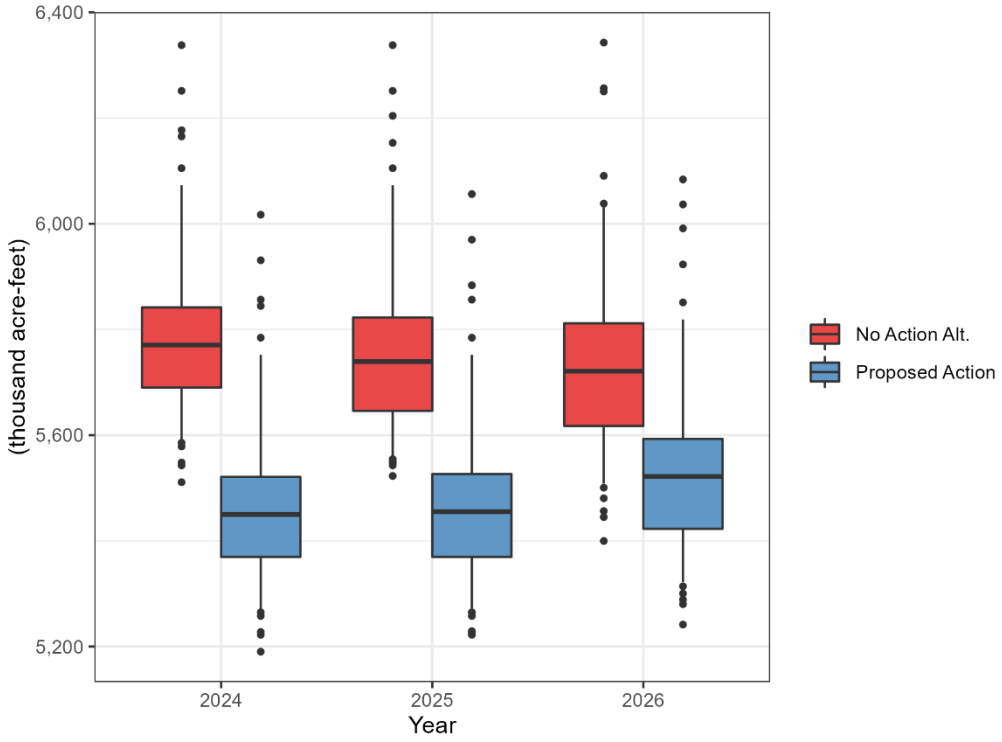
The river flows in the Parker Dam to Cibola Gage reach are essentially the releases from Parker Dam. **Figure 3-18** shows the distributions of modeled annual releases from Parker Dam for all alternatives. In general, the Proposed Action results in lower median annual releases than the No Action Alternative but similar ranges in all years. The minimum annual releases occur in 2026 under the No Action Alternative, and in 2024 and 2025 under the Proposed Action at 6.1 and 6.0 maf, respectively. (See *Issue 2* for additional discussion.)

Two other points on the Colorado River are used to analyze flows in the reach between Parker Dam and Imperial Dam: flows near the Colorado River Indian Reservation (CRIR) and flows downstream of the Palo Verde Diversion Dam. The CRIR diversion is located at Headgate Rock Dam, approximately 14 miles downstream of Parker Dam. Flows in this reach of the river result primarily from releases at Parker Dam, and the annual flow values at this location generally reflect the releases from Parker Dam. Therefore, differences between the alternatives at this location can be assumed to be reflected in the comparison of releases from Parker Dam.

The flow of the Colorado River between Palo Verde Diversion Dam and Imperial Dam is normally the amount needed to meet both the consumptive use requirements in the US downstream of the Palo Verde Diversion Dam and deliveries to Mexico. The river location used to analyze the flows in the reach of the river between Palo Verde Diversion and Imperial Dam is located immediately downstream of the Palo Verde Diversion.

Figure 3-19 shows the distributions of modeled operating year release volumes downstream of the Palo Verde Diversion Dam in 2024, 2025, and 2026. The bold center line of each box represents the median. The boxes capture the 25th to 75th percentiles of the modeled volumes and the whiskers extend to the 5th and 95th percentiles, with outliers represented as dots beyond these lines.

Figure 3-19
Colorado River Annual Flow Downstream of Palo Verde Diversion Dam



In **Figure 3-19**, the distributions of modeled annual flow downstream of Palo Verde Diversion Dam under all alternatives follow the same pattern that was observed in the releases from Parker Dam in **Figure 3-18**; medians and variability in the No Action Alternative remain stable throughout the period of analysis. The median annual release for the Proposed Action is less than the No Action Alternative due to the additional SEIS conservation in the Proposed Action. The minimum annual flows under the No Action Alternative occurs in 2026 at 5.4 maf, while the minimum annual flow under the Proposed Action is 5.2 maf in all years.

Imperial Dam to NIB

Summary of Alternatives Comparison

As discussed in the 2007 FEIS, most water delivered to Mexico is diverted at Imperial Dam, conveyed via the All-American Canal and then returned to the Colorado River through the Pilot Knob and Siphon Drop Powerplants and their respective wasteway channels, 2.1 miles and 7.6 miles upstream of the NIB, respectively. The Proposed Action will not alter operations of these diversions and wasteways.

NIB to SIB

Summary of Alternatives Comparison

As discussed in the 2007 FEIS, Mexico receives most of its Colorado River supply at the NIB and diverts it into the Reforma Canal at the Morelos Diversion Dam. Outflows from the Morelos Diversion Dam into the historical Colorado River floodplain area are normally limited, except

during flood control events or any potential future targeted environmental flows under Minute 323. No Lake Mead flood control releases have occurred since 2008 (after the implementation of the 2007 Interim Guidelines) and none are projected to occur in the next 4 years in the SEIS modeling. Additionally, deliveries to Mexico are outside the scope of this SEIS and, therefore, further analysis is not provided.

Cumulative Effects

The operating tiers established by this SEIS will determine annual release volumes in the LTEMP SEIS. The LTEMP SEIS includes two elements: smallmouth bass flow options and a potential adjustment to HFE sediment account periods and implementation windows. The smallmouth bass flow options would result in temporary changes to daily and hourly flows, which would not impact reservoir levels. Therefore, the potential change of smallmouth bass flow options would result in no changes to annual or monthly reservoir levels in Lake Powell or Lake Mead. The potential adjustment to HFE sediment accounting periods and implementation windows could result in changes in the timing of HFEs, which could minimally affect monthly reservoir levels in Lake Powell and Lake Mead. These differences are expected to be minor, temporary, and resolved by the end of the operating year and would result in no changes to annual reservoir levels in Lake Powell or Lake Mead. Therefore, minimal cumulative effects would occur on flow rates within the various reaches of the Colorado River due to proposed operational changes evaluated in the LTEMP SEIS.

Lastly, no additive cumulative effects would occur on hydrologic resources due to the proposed management activities planned in the Salton Sea 10-Year Plan or the environmental assessment for the implementation of the 10-Year Plan's projects. No cumulative impacts would result as the Proposed Action is not adding additional impacts to those that are already occurring; however, these impacts might occur sooner under the Proposed Action.

Issue 4: How would operational activities affect groundwater?

Based on the modeling assumptions discussed previously, this section presents resulting differences associated with groundwater within specific reaches along the Colorado River for the No Action Alternative and Proposed Action. This qualitative analysis is informed by the assumptions, analyses, and findings of the 2007 FEIS. Further declines to groundwater levels from potential reduced flows are assumed by Reclamation to be similar to those declines presented in the 2007 FEIS.

Glen Canyon Dam to Lake Mead

Summary of Alternatives Comparison

The 2007 FEIS did not consider effects on groundwater elevations in the vicinity of Lake Powell; however, fluctuating reservoir elevations may be mirrored in groundwater elevations adjacent to the reservoir. As discussed in *Issue 1*, both the No Action Alternative and the Proposed Action result in increased monthly median reservoir elevation at Lake Powell, with the median Proposed Action elevations being 1 to 6 feet higher than the median No Action Alternative elevations. The groundwater elevation adjacent to Lake Powell is anticipated to be slightly lower under the No Action Alternative compared with the Proposed Action.

As stated in the 2007 FEIS, the reach of the Colorado River downstream of the Glen Canyon Dam runs through the incised Grand Canyon, where there is limited connection to groundwater. Due to

these physical characteristics, Reclamation assumes there are no differences between the No Action and Proposed Action. The Proposed Action is not anticipated to affect groundwater levels within this reach.

The 2007 FEIS did not consider effects on groundwater elevations in the vicinity of Lake Mead; however, fluctuating reservoir elevations may be mirrored in groundwater elevations adjacent to the reservoir. As discussed in *Issue 1*, the No Action Alternative exhibits a declining trend in median elevations through the analysis period. The Proposed Action median elevations are higher than the No Action Alternative elevations and exhibit an upward trend through the analysis period. Groundwater elevations adjacent to Lake Mead may fluctuate throughout the analysis period. At the end of 2026, groundwater elevation adjacent to Lake Mead is anticipated to decrease under the No Action Alternative, whereas groundwater elevations may increase under the Proposed Action.

Hoover Dam to Davis Dam

Summary of Alternatives Comparison

As stated in the 2007 FEIS, this reach of the Colorado River runs through bedrock canyon that has limited connection to groundwater, or the reach is part of a groundwater basin dominated by Lake Mohave. Reclamation assumes there are no differences between the alternatives, and the alternatives are not anticipated to impact groundwater levels within this reach.

Davis Dam to Parker Dam

Summary of Alternatives Comparison

Due to the physical characteristics of the Davis Dam to Parker Dam reach of the Colorado River, groundwater levels are anticipated to decrease in the upper portion of the reach and remain static in the lower portion under all alternatives. As discussed in *Issue 3*, river flows could decrease more under the Proposed Action. Decreasing river flows and shallower river stages in this reach have historically resulted in decreased groundwater elevations. Reductions in the groundwater elevation in the upper portion of this reach are anticipated to be larger under the Proposed Action, compared with the No Action Alternative, due to SEIS conservation volumes lowering flow rates through this portion of the Colorado River.

Parker Dam to Cibola Gage and Cibola Gage to Imperial Dam

Summary of Alternatives Comparison

Due to the physical characteristics of the Parker Dam to Imperial Dam reach of the Colorado River, groundwater levels are anticipated to decrease under all alternatives. As discussed in *Issue 3*, river flows could decrease more under the Proposed Action. Decreasing river flows and shallower river stages in this reach have historically resulted in decreased groundwater elevations. Reductions in the groundwater elevation are anticipated to be larger under the Proposed Action, compared with the No Action Alternative, due to SEIS conservation volumes lowering flow rates through this portion of the Colorado River.

Imperial Dam to NIB

Summary of Alternatives Comparison

As stated in the 2007 FEIS, this reach of the Colorado River either runs through two small rockbound groundwater basins or is diverted to the All-American Canal. Reclamation assumes there are no differences between the alternatives, and the alternatives are not anticipated to impact groundwater levels within this reach.

NIB to SIB

Summary of Alternatives Comparison

As stated in the 2007 FEIS, this reach of the Colorado River runs through the large and deep river delta. The upstream portion is a gaining reach where groundwater contributes to surface flow in the river. The downstream portion is a losing reach where surface water from the river recharges the groundwater. While the Proposed Action alters the flow in the Lower Basin reaches differently than the No Action Alternative, impacts on groundwater levels across all alternatives are not anticipated within this reach.

Cumulative Effects

The operating tiers established by this SEIS will determine annual release volumes in the LTEMP SEIS, however this would result in negligible changes to groundwater resources. The LTEMP SEIS includes two elements: smallmouth bass flow options and a potential adjustment to HFE sediment account periods and implementation windows. The smallmouth bass flow options would result in temporary changes to daily and hourly flows, which would not impact reservoir levels. Therefore, the potential change of smallmouth bass flow options would result in no changes to annual or monthly reservoir levels in Lake Powell or Lake Mead. The potential adjustment to HFE sediment accounting periods and implementation windows could result in changes in the timing of HFEs, which could minimally affect monthly reservoir levels in Lake Powell and Lake Mead. These differences are expected to be minor, temporary, and resolved by the end of the operating year and would result in no changes to annual reservoir levels in Lake Powell or Lake Mead. Therefore, no cumulative effects would occur on groundwater levels within the various reaches of the Colorado River due to proposed operational changes evaluated in the LTEMP SEIS.

Lastly, no additive cumulative effects would occur on hydrologic resources due to the proposed management activities planned in the Salton Sea 10-Year Plan or the environmental assessment for the implementation of the 10-Year Plan's projects. No cumulative impacts would result as the Proposed Action is not adding additional impacts to those that are already occurring; however, these impacts might occur sooner under the Proposed Action.

3.7 Water Deliveries

3.7.1 Affected Environment

As described in the 2007 FEIS, entities in the seven Basin States and Mexico receive water from the Colorado River. The Law of the River governs these deliveries. Since publication of the 2007 FEIS, deliveries to the Lower Division States have been adjusted to meet the 2007 Interim Guidelines

under certain conditions (Shortage Condition Years) and the Lower Basin DCP (Reclamation 2019b). Actions under the Upper Basin DCP's Drought Response Operating Agreement have also been implemented since publication of the 2007 FEIS with the goal of reducing the risk of reaching critical elevations at Lake Powell and helping assure continued compliance with the Colorado River Compact by moving water within the Upper Basin. Otherwise, deliveries to these entities are guided by the same body of documents described in the 2007 FEIS.

The Compact, described in the 2007 FEIS, ultimately apportioned water for consumptive use (7.5 maf each) between the Upper and Lower Basins, with the division of the two basins at Lee Ferry, Arizona. The Upper and Lower Basins further apportion deliveries to individual states and entities within their respective basins. As discussed within this SEIS, the 2007 Interim Guidelines outline shortage guidelines that describe the agreed-upon reductions of available water for consumptive use to the Lower Division States below their apportioned 7.5 maf. Additionally, the 2007 Interim Guidelines modified and extended the 2001 Interim Surplus Guidelines (DOI 2001) from 2016 to 2026.

This section presents updated information on the Basin through 2022 to better describe evolving characteristics of water deliveries within the affected environment. This includes updated information regarding the apportionments to Upper and Lower Division States, entitlements, depletion schedules for Lower Division States, and distribution of shortages for the Lower Division States.

Apportionments to the Upper Division States

As described in the 2007 FEIS, the Compact apportions 7.5 maf to the Upper Basin for consumptive use. Furthermore, flow at the Lee Ferry Compact Point cannot be depleted below 75 maf for any consecutive 10-year period. The annual apportionment is a percentage of the total available for consumptive use each year. The available amount within the Upper Basin is the remaining volume after Arizona's 50,000 af apportionment of Upper Basin water. Additional details on the Upper Division States' apportionments and depletion schedules are in the 2007 FEIS and apportionments are listed in **Table 3-6**. The 2007 Interim Guidelines do not affect apportionments of the Upper Division States.

Table 3-6
Upper Division States Apportionment

State	Annual Apportionment (Percent)
Colorado	51.75
New Mexico	11.25
Utah	23.00
Wyoming	14.00

Source: Reclamation 2007

Apportionments to the Lower Division States

As stated in the 2007 FEIS, the BCPA establishes water apportionments to the Lower Division States. Details on these states' apportionments are in the 2007 FEIS and are listed in **Table 3-7**.

Table 3-7
Lower Division States Apportionments

State	Annual Apportionment (maf)
Arizona	2.8
California	4.4
Nevada	0.3
Total	**7.5**

Source: Reclamation 2007

The 2007 Interim Guidelines do not affect apportionments of water to the Lower Division States. Therefore, further discussion of these apportionments is not warranted; additional details are in the 2007 FEIS.

Water Delivery Entitlements to Entities in the Lower Division States

As stated in the 2007 FEIS, the Lower Division States' apportioned water is further allocated through entitlements, in accordance with the BCPA and Consolidated Decree.[7] Approximately 10,000 af of Arizona's lower Colorado River water apportionment has not been placed under a water delivery contract. The 2007 Interim Guidelines do not affect entitlements in the Lower Division States; additional details on these entitlements are in the 2007 FEIS.[8]

Intentionally Created Surplus

Additionally, the 2007 Interim Guidelines created the mechanism of ICS, allowing Lower Basin entitlement holders with ICS exhibits and an approved ICS creation plan to store conserved water in Lake Mead. Approved conservation actions, consistent with an ICS exhibit, must be taken to create ICS in a given year. ICS creation and deliveries are subject to constraints, as defined in the 2007 ROD and 2019 DCPs agreements (specifically, Exhibit 1) and related ICS delivery agreements.

Lower Division States' Water Supply Determination

As discussed in the 2007 FEIS, the Secretary annually determines the water supply condition for the Lower Division States as a normal condition, surplus condition, or shortage condition, depending on the amount of mainstream water available to satisfy consumptive use in the Lower Division States. The 2007 Interim Guidelines provide specific guidance used to make annual water supply determinations. This guidance is based on the projected elevation of Lake Mead based on the August 24-Month Study. The guidance identifies thresholds under which the Secretary would reduce the total amount of water available—below 7.5 maf—for consumptive use from Lake Mead to the Lower Division States. The 2007 Interim Guidelines also provide a coordinated approach to reservoir management between Lake Powell and Lake Mead.

Starting in 2008, Reclamation has operated Lake Powell for each operating year based on certain release tiers, which is consistent with Section 6 of the 2007 Interim Guidelines. Similarly, Reclamation has set the condition governing operation of Lake Mead for each operating year,

[7] As discussed in the 2007 FEIS, the Consolidated Decree was entered by the US Supreme Court in the case of *Arizona v. California*, 547 US 150 (2006).
[8] See also: https://www.usbr.gov/lc/region/g4000/contracts/entitlements.html.

consistent with Section 2 of the 2007 Interim Guidelines and in accordance with Article III(3)(c) of the Operating Criteria and Article II(B)(3) of the Consolidated Decree of the Supreme Court of the US in *Arizona v. California*, 547 US 150 (2006). Starting in 2019, the Lower Basin DCP (Reclamation 2019b) also governs the operation of Lake Mead.

Each year's AOP for Colorado River reservoirs reports on both the past operations of the Colorado River reservoirs for the completed year and the projected operations and releases from these reservoirs for the current (that is, upcoming) year. Each AOP incorporates rules, guidelines, and decisions. The AOP reports how Reclamation will implement these decisions in response to changing water supply conditions as conditions become known during the upcoming year. In accordance with Section 2 of the 2007 Interim Guidelines, Lake Mead operated in an ICS/Surplus Condition from 2008 through 2021 and in a Shortage Condition in 2022 and 2023, with required DCP contributions in years from 2020 through 2023.

As discussed in the 7D Review Final Report, released in December 2020 (Reclamation 2020a), the Interim Guidelines provide operational criteria for the full range of potential reservoir elevations that may occur based on modeling conducted for the 2007 FEIS. The guidelines were intended to govern operations through 2026, however, the continuing drought within the Basin has increased the probability that the water supply system will be unable to make required releases. In addition, reservoir levels have continued to fall to the point that critical infrastructure and hydropower operations may be negatively affected.

This fact motivated the completion of the DCPs when, in 2018, combined storage was at the lowest point since Lake Powell filled (41 percent full), and the Basin was experiencing the second-driest year since the beginning of the drought (Reclamation 2020a). Even with the DCPs in place, the risk of continued drought and reservoir elevations declining below those considered likely in the 2007 FEIS requires the consideration of updates to the 2007 Interim Guidelines to protect the reservoir elevations of Lake Powell and Lake Mead through 2026. Proposed updates under consideration (Proposed Action) and their effect on water deliveries to Lower Division States are presented in **Section 3.7.2**, Environmental Consequences, of this SEIS.

Depletion Schedules for Lower Division States (Normal and Surplus)

Historical consumptive use for the Lower Basin from 2008 to 2022 is shown in **Table 3-8**. 2008 was selected since that is when the 2007 Interim Guidelines were implemented. At the time of this report, data was not available after 2022. Total annual depletions to the Lower Basin have declined on average from 2008 to 2022.

Table 3-8
Lower Basin Annual Historical Consumptive Use by State

Calendar Year	Arizona (af)	California (af)	Nevada (af)	Lower Basin Total (af)
2008	2,752,497	4,498,810	269,654	7,520,961
2009	2,831,711	4,358,074	248,613	7,438,398
2010	2,780,367	4,356,839	241,437	7,378,643

Calendar Year	Arizona (af)	California (af)	Nevada (af)	Lower Basin Total (af)
2011	2,781,108	4,312,661	222,847	7,316,616
2012	2,789,667	4,416,718	237,161	7,443,546
2013	2,778,867	4,475,789	223,563	7,478,219
2014	2,774,661	4,649,734	224,616	7,649,011
2015	2,604,732	4,620,756	222,729	7,448,217
2016	2,612,833	4,381,101	238,326	7,232,260
2017	2,509,503	4,026,515	243,425	6,779,443
2018	2,632,260	4,265,525	244,103	7,141,888
2019	2,491,707	3,840,686	233,996	6,566,389
2020	2,470,776	4,059,911	255,568	6,786,255
2021	2,425,736	4,404,727	242,168	7,072,631
2022	2,014,176	4,424,247	223,670	6,662,093

Source: Reclamation 2022c

Projected depletion schedules have been modified since the 2007 FEIS. **Appendix D** outlines the current depletion schedules used in normal and surplus[9] conditions. For the first year of the model run, projected depletion schedules use water orders that reflect shortage conditions, DCP contributions, and other signed system conservation agreements. For the remaining years in the model run, projected depletion schedules reflect "normal" schedules and represent near-term historical trends in water use.

Mexico's Allotment

Allotment specifics are detailed in the 2007 FEIS. The 2007 Interim Guidelines and this SEIS do not affect Mexico's allotment. The amount of Colorado River water scheduled for delivery to Mexico during each operating year has been set in accordance with the 1944 Water Treaty and Minute 323. Since 2019, this volume was further adjusted for water savings contributions, as required under Minute 323, and since 2021 for reductions under low elevation reservoir conditions. In accordance with the provisions of Minute 323,[10] Mexico may create water for or take delivery of water from Mexico's Water Reserve. The provisions also allow Mexico's Water Reserve to be converted into Mexico's Recoverable Water Savings, which offset savings contributions when Lake Mead has low reservoir elevations for recovery on a future date.

Distribution of Shortages to and within the Lower Division States

The 2007 FEIS describes the distribution of shortages within each state, in accordance with established priority systems and agreements. This section provides supplemental information that impacts the distribution of shortages since publication of the 2007 FEIS.

[9] While surplus schedules exist in CRMMS, no surplus conditions are projected through 2026 in the No Action Alternative or the Proposed Action.

[10] For implementing additional details, see the *Joint Report of the Principal Engineers with the Implementing Details of the BWSCP in the Colorado River Basin dated July 11, 2019,* and the *Joint Report of the Principal Engineers with the Operational Provisions Applicable to Water for the Environment Stipulated in Minute 323 dated December 16, 2021.*

In the 2007 FEIS, the maximum volume of domestic shortages analyzed in the shortage allocation model was 2.083 maf. As such, the total shortages, DCP contributions, and SEIS conservation modeled in this SEIS are limited to 2.083 maf, the maximum volume contemplated in the 2007 FEIS. Working within this range of previously analyzed impacts will facilitate efficient analysis. Shortage volumes above this amount are uncertain and are unable to be analyzed in this SEIS. Delaying operational decisions to perform additional analyses would not meet the express purpose and need for this action.

The 2007 Interim Guidelines specified shortages for Arizona and Nevada based on the projected January 1 elevation of Lake Mead. The 2019 DCPs included additional contributions from Arizona, Nevada, and California at specified Lake Mead elevations. The breakdown of these volumes is described in Exhibit 1 to the Lower Basin DCP Agreement. **Table 3-9** presents this breakdown.

Table 3-9
Lower Division States' Total Shortages from the 2007 Interim Guidelines and Contributions from the 2019 DCPs

Projected January 1 Lake Mead Elevation (feet)	2007 Interim Guidelines Shortages		DCP Contributions			Combined Volumes (2007 Interim Guidelines Shortages & DCP Contributions)			
	Arizona	Nevada	Arizona	Nevada	California	Arizona	Nevada	California	Lower Division States Total
	(1,000 acre-feet)								
At or below 1,090 and above 1,075	0	0	192	8	0	192	8	0	200
At or below 1,075 and at or above 1,050	320	13	192	8	0	512	21	0	533
Below 1,050 and above 1,045	400	17	192	8	0	592	25	0	617
At or below 1,045 and above 1,040	400	17	240	10	200	640	27	200	867
At or below 1,040 and above 1,035	400	17	240	10	250	640	27	250	917
At or below 1,035 and above 1,030	400	17	240	10	300	640	27	300	967
At or below 1,030 and at or above 1,025	400	17	240	10	350	640	27	350	1,017
Below 1,025	480	20	240	10	350	720	30	350	1,100

Source: Reclamation 2019b

Distribution of Shortages within Arizona

As described in the 2007 FEIS, Arizona's 2.8 maf apportionment is further allocated to entitlement holders. A priority system was established for the delivery of mainstream Colorado River water. **Table 3-10,** which is taken from the 2007 FEIS, outlines Arizona's priority system.

Table 3-10
Arizona's Priority System for Mainstream Colorado River Water

Priority	Rights to Be Satisfied
First	Present perfected rights (PPRs) established prior to June 25, 1929
Second[1]	Federal reservations and perfected rights established or effective prior to September 30, 1968
Third[1]	Entitlements pursuant to contracts executed on or before September 30, 1968
Fourth	(1) Entitlements pursuant to contracts, Secretarial reservations, and other arrangements between the US and water users established subsequent to September 30, 1968 (2) Contract for CAP
Fifth	Any unused Arizona entitlement
Sixth	Entitlements to surplus water

Source: Reclamation 2007

[1] The Arizona second and third priorities are coequal in their priority.

As described above, the 2007 Interim Guidelines and the 2019 DCPs define shortages and contributions from Arizona, which depend on the elevation of Lake Mead. The combined shortage and contribution volumes for Arizona range from 192,000 af to 720,000 af.

Distribution of Shortages within California

As described in the 2007 FEIS, California's 4.4-maf apportionment is further distributed through a priority system, established by Secretarial regulations incorporating provisions of the California Seven-Party Agreement of 1931. **Table 3-11** from the 2007 FEIS outlines the priority system.

Table 3-11
California's Seven-Party Agreement for Mainstream Colorado River Water

Priority	Rights to Be Satisfied
First	Palo Verde Irrigation District for beneficial use upon 104,500 acres
Second	Reclamation's Yuma Project for beneficial use on up to 25,000 acres
Third[1,2]	(a) IID and CVWD (b) Palo Verde Irrigation District for use on 16,000 acres on the Lower Palo Verde Mesa
Fourth[3]	MWD and/or the City of Los Angeles and/or others on the coastal plain of Southern California for 550,000 acre-feet per year (afy)
Fifth	(a) MWD and/or the City of Los Angeles and/or others on the coastal plain of Southern California for 550,000 afy (b) City and/or County of San Diego for 112,000 afy
Sixth[4]	(a) IID and CVWD (b) Palo Verde Irrigation District for use on Lower Palo Verde Mesa
Seventh	All remaining water available within California for agricultural use

Source: Reclamation 2007

[1] The total beneficial use of priorities 1, 2, and 3 shall not exceed 3,850,000 afy.

[2] Article 4.7 of the Quantification Settlement Agreement (QSA) and the Agreement for Acquisition of Conserved Water by and between IID and Coachella Valley Water District, dated October 10, 2003, contain provisions for shortage sharing between these two agencies.

[3] The sum of priorities 1 through 4 is 4,400,000 afy.

[4] The sum of priority 6 is 300,000 thousand afy.

As outlined above, the 2019 DCPs defines contributions from California, which depend on the elevation of Lake Mead. The contribution volumes for California range from 0 af to 350,000 af.

Distribution of Shortages within Nevada

As described in the 2007 FEIS, Nevada's 0.3-maf apportionment is further distributed through a priority system, established in 1992 when Reclamation contracted with SNWA for delivery of the balance of Nevada's apportionment. **Table 3-12**, updated from the 2007 FEIS, outlines the priority system.

Table 3-12
Nevada's Priority System for Mainstream Colorado River Water

Priority	Rights to Be Satisfied
First	Fort Mojave Indian Reservation (12,534 afy) LMNRA (Diversion = 500 afy or Consumptive Use = 300 afy)
Second	LMNRA (1,500 afy, estimated)
Third	Boulder City (5,876 afy)
Fourth	City of Henderson (15,878 afy) Basic Management, Inc. (8,608 afy) SNWA (from Basic Water Company) (14,950 afy)
Fifth	Lakeview Company (0 afy) Pacific Coast Building Products (PABCO) (928 afy)
Sixth	Las Vegas Valley Water District (15,407 afy)
Seventh	US Air Force (delivery from SNWA; 4,000 afy), Boy Scouts (annexed by SNWA; 10 afy), Reclamation (300 afy), and Nevada Department of Wildlife (formerly Nevada Department of Fish and Game; 25 afy)
Eighth	Robert B. Griffith Project (308,000 afy) and Big Bend (10,000 afy) SNWA (balance of state apportionment, unused and surplus)

Source: Reclamation 2007

As outlined above, the 2007 Interim Guidelines and the 2019 DCPs define shortages and contributions from Nevada, which depend on the elevation of Lake Mead. The combined shortage and contribution volumes for Nevada range from 8,000 af to 30,000 af.

Salton Sea

The Salton Sea is a terminal lake that receives runoff from the surrounding Imperial Valley and Coachella Valley watersheds, as well as agricultural runoff from the IID and CVWD. This runoff primarily originates as deliveries from the Colorado River Basin to IID and CVWD. Historically, the Salton Sea's water level has declined, increasing lakebed exposure area over the past decades (Tetra Tech 2023). Future Salton Sea conditions were modeled using the SSAM. Additional information regarding the modeling specifics can be found in **Section 3.3.6**.

3.7.2 Environmental Consequences

Methodology

This section compares water deliveries from the Colorado River mainstream under the No Action Alternative and the Proposed Action. The CRMMS, as described in **Section 3.3**, was used to analyze water deliveries across these alternatives. Modeling details for each alternative are described in **Section 3.3.4** and **Appendix D**.

Additionally, as described in **Section 3.3**, a Shortage Allocation Model was used in addition to the CRMMS to analyze the potential impacts of the alternatives on individual water users within each Lower Division State. The Shortage Allocation Model was used to estimate delivery of water to Colorado River water users within the Lower Division States under varying levels of shortage for the No Action Alternative. The same assumptions are made for the Proposed Action; therefore, the Shortage Allocation Model is relevant to both alternatives. Modeling assumptions for the Shortage Allocation Model are summarized in **Section 3.3.4** and detailed in **Appendix E** which presents shortage impacts on entitlement holders. A list of each Lower Division State's Colorado River water-entitlement holders, listed by priority, is available at: https://www.usbr.gov/lc/region/g4000/contracts/entitlements.html.

The new actions evaluated as part of the SEIS will not impact Upper Division States; therefore, further analysis of the Upper Division States is not necessary and not included within this section.

Assumptions

(Please refer to **Section 3.3.4**, **Appendix D**, and **Appendix E** for a discussion pertaining to modeling assumptions.)

All calculated statistics are reflective of the hydrology scenarios and other assumptions used in modeling, and they are not intended to suggest actual probabilities of any events occurring. However, it is meaningful to compare statistics across alternatives to differentiate performance.

Impact Indicators

This section will discuss impacts on the Lower Division States' water supply determination, total water deliveries to Lower Division States, deliveries to Mexico, and the distribution of shortages to and within the Lower Division States. To measure the impact of water deliveries, the following indicators are used:

- frequency and magnitude of shortages
- distribution of shortages and depletions among and within the Lower Division States

Additionally, impacts on the Salton Sea are included.

Issue 1: How would changes to operational activities affect apportionments to the Upper Division States?

The alternatives would not affect apportionments to the Upper Division States. Therefore, no impact analysis is warranted.

Issue 2: How would changes to operational activities affect apportionments and water entitlements to and within the Lower Division States?

The alternatives would not affect state apportionments or entitlements of water users within the Lower Division States. Therefore, no impact analysis is warranted.

Issue 3: How would changes to operational activities affect Lower Division States' water supply determinations and total water deliveries?

This section presents the water supply determinations and resulting water deliveries (i.e., modeled depletions) to the three Lower Division States. Deliveries to each state may deviate from a state's normal apportionment due to shortage or surplus conditions, DCP contributions, ICS creation and delivery, and other system conservation, including SEIS conservation (under the Proposed Action).

Summary of Alternatives

As discussed in **Chapter 2** and **Appendix D** shortage and DCP contribution determinations for both alternatives are determined in response to Lake Mead elevations. These volumes are outlined in **Table 3-13** for the No Action Alternative and **Table 3-14** for the Proposed Action. Additionally, the Proposed Action includes modeled SEIS conservation volumes, described in the modeling assumptions in **Section 3.3.4**.

Table 3-13
Lower Division States' Shortages and DCP Contributions, No Action Alternative*

Lake Mead Elevation (feet)	2007 ROD** Shortages (1,000 af)	2019 DCP Contributions (1,000 af)	Total ROD Shortages + Contributions (1,000 af)
1,090 – >1,075	0	200	**200**
1,075 – 1,050	333	200	**533**
<1,050 – >1,045	417	200	**617**
1,045 – >1,040	417	450	**867**
1,040 – >1,035	417	500	**917**
1,035 – >1,030	417	550	**967**
1,030 – 1,025	417	600	**1,017**
<1,025	500	600	**1,100**

* This table only shows combined Lower Division State shortage volumes and DCP contributions. In addition to the volumes shown in this table, the analysis for each alternative includes water delivery reductions to Mexico under low-elevation reservoir conditions and Mexico's savings that contribute to the Binational Water Scarcity Contingency Plan (BWSCP), in accordance with Minute 323 to the 1944 Water Treaty (see **Appendix D**, CRMMS Model Documentation, **Tables D-9** and **D-10**).

** Shortages listed in the 2007 ROD

Table 3-14
Lower Division States' Shortages, DCP Contributions, and SEIS Conservation, Proposed Action (2023-2026)*

Lake Mead Elevation (feet)	2007 ROD Shortages (1,000 af)	2019 DCP Contributions (1,000 af)	SEIS Conservation (1,000 af)	Total ROD Shortages + DCP Contributions + SEIS Conservation (1,000 af) **
1,090 – >1,075	0	200	Approximately 750 annually**	**950**
1,075 – 1,050	333	200		**1,283**
<1,050 – >1,045	417	200		**1,367**
1,045 – >1,040	417	450		**1,617**
1,040 – >1,035	417	500		**1,667**
1,035 – >1,030	417	550		**1,717**
1,030 – 1,025	417	600		**1,767**
<1,025	500	600		**1,850**

* This table only shows combined Lower Division State shortages, DCP contributions, and SEIS conservation. In addition to the volumes shown in this table, the analysis for each alternative includes water delivery reductions to Mexico under low-elevation reservoir conditions and Mexico's savings that contribute to the BWSCP, in accordance with Minute 323 to the 1944 Water Treaty (see **Appendix D**, CRMMS Model Documentation, **Tables D-9** and **D-10**).
** The amount of SEIS conservation could be higher or lower in a given year depending on the conservation agreements in place in that year. The total of ROD shortages, DCP contributions, SEIS conservation, and any other additional conservation would not exceed 2.083 maf in a given year.

Modeled Lake Mead elevations are lower throughout the period of analysis for the No Action Alternative compared to the Proposed Action, resulting in more traces at tiers with greater combined shortages and DCP contributions compared to the Proposed Action. Although median combined shortages and DCP contributions are the same for both alternatives throughout the period of analysis, slight differences in minimum and maximum volumes occur between alternatives due to differences in the percent of traces in each operating tier.

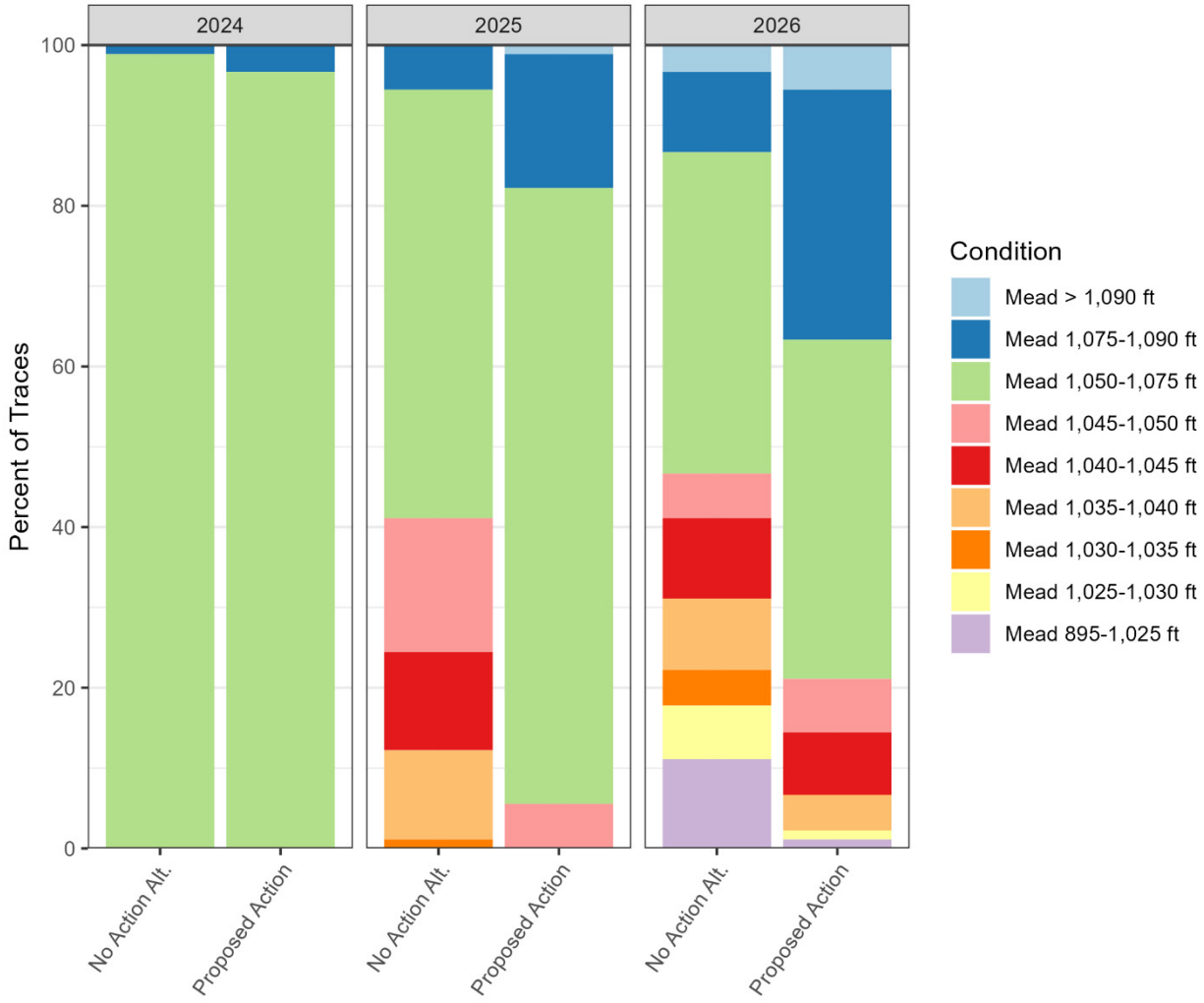
System conservation is greater under the Proposed Action each year compared to the No Action Alternative due to the SEIS Conservation included in the Proposed Action. This results in greater combined annual shortages, DCP contributions, and system conservation under the Proposed Action each year, except for in Nevada, where no system conservation occurs.

Modeled depletions, which incorporate the effects of ICS, under the No Action Alternative exceed those of the Proposed Action each year due to the additional SEIS Conservation included in the Proposed Action. However, under the Proposed Action, SEIS Conservation contributes to increasing elevations at Lake Mead, reducing the risk of shortages and DCP contributions to the Lower Division States in the later years of the analysis period.

Lower Basin Operating Condition

Figure 3-20 shows the percentage of modeled traces that were within each operational condition for the period of analysis. Under both alternatives, the applicable Operational Tier would continue to be based on the August 24-Month Study projection of the January 1 system storage and reservoir water

Figure 3-20
Percent of Traces with Lower Division Shortage and DCP Tiers



surface elevations in Lake Mead for the following operating year. Each color represents a different threshold of shortage and DCP tier conditions based on **Table 3-13** and **Table 3-14**. **Figure 3-8** in **Section 3.6.2** shows the projected end-of-month pool elevations for Lake Mead from 2023 through 2026 for both alternatives.

As shown in **Figure 3-20**, in 2024, all modeled traces in both the No Action Alternative and Proposed Action experience December 31 Lake Mead elevations below the threshold for DCP contributions (1,090 feet) or shortages (1,075 feet). As shown in **Figure 3-8**, throughout the period of analysis, the range of hydrologic traces in the No Action Alternative result in lower monthly Lake Mead elevations than the Proposed Action. Under the Proposed Action, the median elevation of Lake Mead is higher than the No Action Alternative and exhibits an upward trend throughout the period of analysis. As a result, in each year, the No Action Alternative has more traces at operating conditions with greater combined shortages and DCP contributions compared with the Proposed Action.

Distribution of Lower Division States Shortages and DCP Contributions

Specified shortage volumes and DCP contributions for the combined Lower Division States at different Lower Basin operating conditions are the same for both alternatives and shown in **Table 3-14**. Combined specified shortage volumes and DCP contributions broken down by Lower Division State are in **Table 3-1** in **Section 3.3.5**.

Figure 3-21 shows the distributions of Lower Division shortages and DCP contributions as a total and for each state in 2024, 2025, and 2026. The results are presented as a percent of apportionment and volume. The median modeled values are represented by the colored bar and the mid-line in the boxplots. The boxes capture the 25th to 75th percentiles of the modeled values and the whiskers extend to the 5th and 95th percentiles, with outliers represented as dots beyond these lines.

As shown in **Figure 3-21**, the median modeled combined annual shortage volumes and DCP contributions are the same across both alternatives at 533,000 af and are consistent within each state throughout the period of analysis. The maximum and minimum volumes change through time and between alternatives with slightly lower volumes in the Proposed Action compared to the No Action Alternative. These slight differences are due to the difference in the percent of traces in each operating tier under each alternative, as described for **Figure 3-20**.

The maximum total modeled Lower Division States combined shortage volumes and DCP contributions for operating year 2024 for the No Action Alternative and Proposed Action are 533,000 af. The maximum total modeled Lower Division States combined annual shortage volumes and DCP contributions are 967,000 af for 2025 and 1.1 maf for 2026 under the No Action Alternative. The maximum total modeled Lower Division States combined annual shortage volumes and DCP contributions are 617,000 af for 2025 and 1.1 maf for 2026 under the Proposed Action.

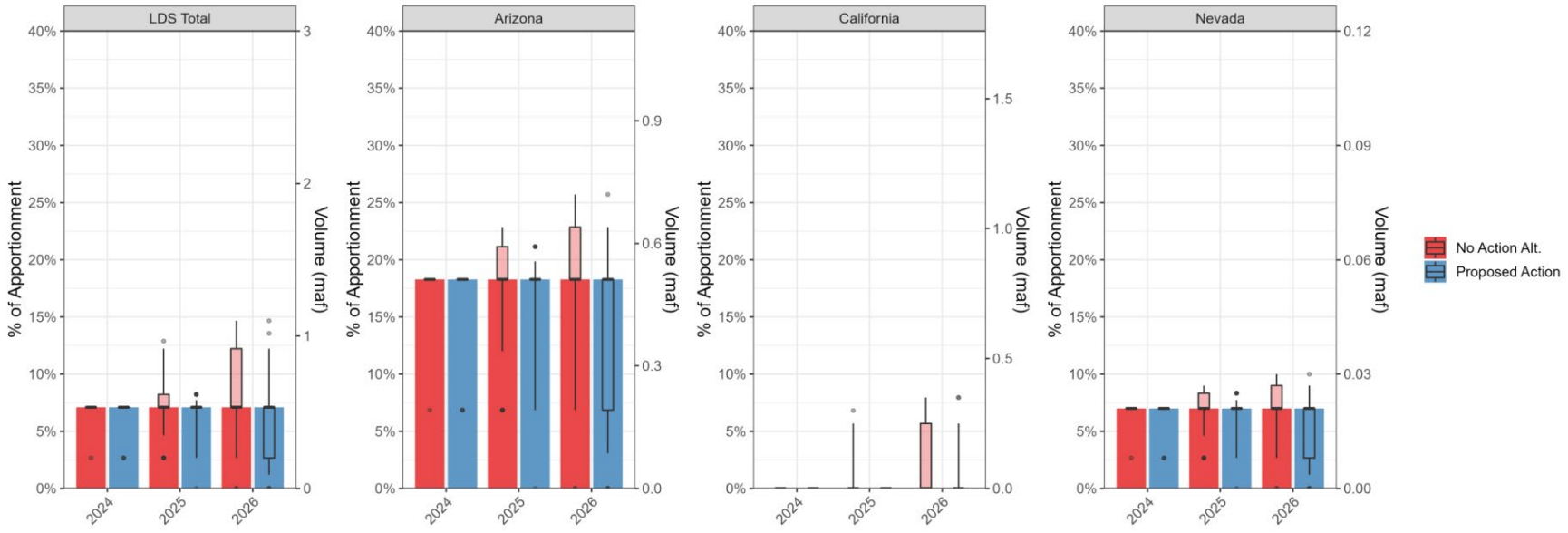
Combined Shortages and DCP Contributions for Arizona

For operating years 2024–2026, the median modeled combined annual shortage volumes and DCP contributions under the No Action Alternative for Arizona are constant for both alternatives and for the entire period at 512,000 af. However, the maximum volumes increase each year under both alternatives, but with slight differences in volume due to the difference in the percent of traces in each operating tier under each alternative. For the No Action Alternative, the maximum volumes are 512,000 af, 640,000 af, and 720,000 af, for 2024–2026, respectively. For the Proposed Action, the maximum combined shortage volumes and DCP contributions are 512,000 af, 592,000 af, and 720,000 af for 2024–2026, respectively.

Combined Shortages and DCP Contributions for Nevada

For operating years 2024–2026, the median modeled combined annual shortage volumes and DCP contributions under the No Action Alternative for Nevada are constant for both alternatives and for the entire period at 21,000 af. In 2024, the maximum volumes are also the same across each alternative at 21,000 af. However, the maximum volumes slightly differ between the alternatives in 2025 due to the difference in the percent of traces in each operating tier under each alternative, at 27,000 af for the No Action Alternative and 25,000 af for the Proposed Action. In 2026, the maximum volumes are again the same across the alternatives at 30,000 af.

Figure 3-21
Distribution of Lower Division States' Combined Shortages and DCP Contributions



Combined Shortages and DCP Contributions for California

California does not take shortages under either alternative, so this analysis represents only DCP Contributions for California. For operating years 2024–2026, the median modeled DCP contributions under the No Action Alternative for California are constant for both alternatives and for the entire period at zero, because the majority of traces stay above elevation 1,045 feet at Lake Mead – the elevation where California begins making DCP contributions. In 2024, California has no modeled DCP contributions in either alternative in any trace. In 2025, the maximum DCP contributions differ between the alternatives due to the difference in the percent of traces in each operating tier under each alternative, at 300,000 af under the No Action Alternative and zero for the Proposed Action. In 2026, the maximum modeled California DCP contributions are 350,000 af under both alternatives.

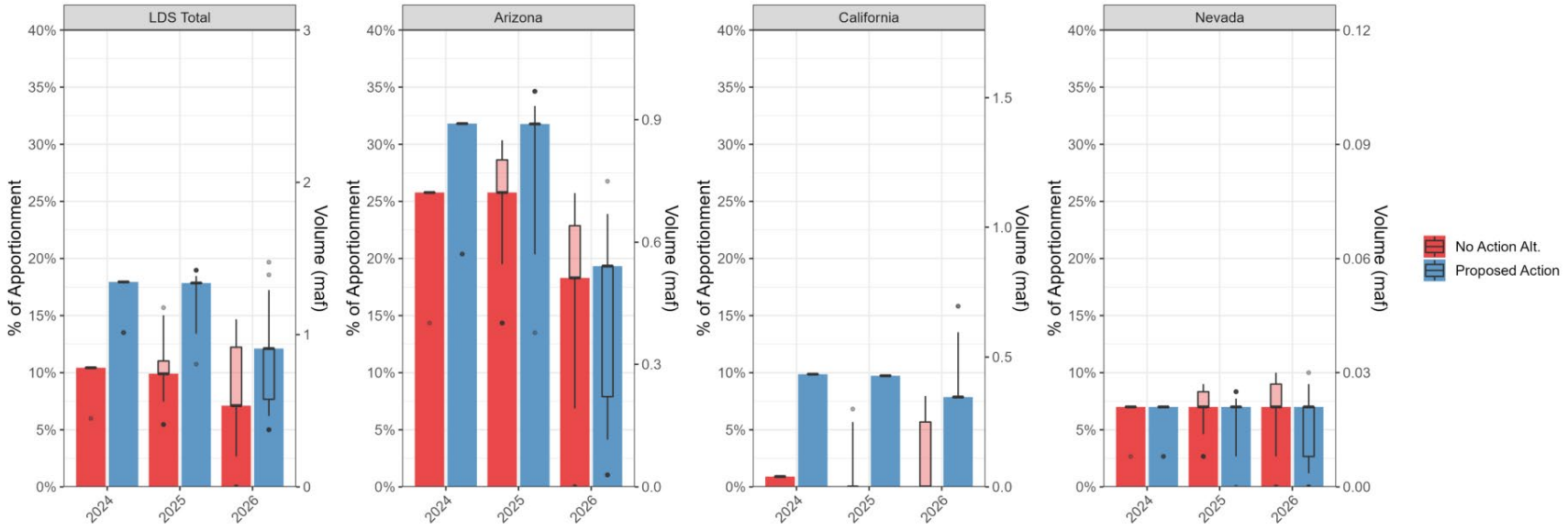
Distribution of Lower Division Shortages, DCP Contributions, and System Conservation

Specified shortage volumes, DCP contributions, and system conservation for the combined Lower Division States at different Lower Basin operating conditions are shown in **Table 3-14.** Combined specified shortage volumes, DCP contributions, and system conservation broken down by Lower Division State are in **Table 3-1** in **Section 3.3.5**.

Figure 3-22 shows the distributions of Lower Division shortages, DCP contributions, and system conservation as a total and for each state in 2024, 2025, and 2026. The results are presented as a percent of apportionment and volume. The median modeled values are represented by the colored bar and the mid-line in the boxplots. The boxes capture the 25th to 75th percentiles of the modeled volumes and the whiskers extend to the 5th and 95th percentiles, with outliers represented as dots beyond these lines. **Figure 3-22** is similar to **Figure 3-21** except that it includes modeled system conservation. Modeling assumptions, including the volumes of system conservation in each alternative, are stated in **Section 3.3.4** and are described in detail in **Appendix D.**

As shown in **Figure 3-22**, the total modeled Lower Division State median combined annual shortage volumes, DCP contributions, and system conservation are greater in each year under the Proposed Action compared to the No Action Alternative due to the additional SEIS conservation in the Proposed Action. For 2024–2026, the No Action Alternative has a total of 409 kaf of system conservation and the Proposed Action has a total of 1,943 kaf of SEIS conservation. If 2023 is included, the No Action Alternative has a total of 665 kaf of system conservation through 2026, and the Proposed Action has a much greater volume at a total of 2,468 kaf of SEIS conservation. Most of the SEIS conservation is modeled to occur between 2023 and 2025. A breakdown of the SEIS conservation by state and user is shown in **Table 3-2** in **Section 3.3.5**. Note that the volumes for SEIS conservation are modeling assumptions and do not represent mandatory shortages. The SEIS conservation was modeled to occur in every trace, meaning it will be a constant increase in the total modeled shortages and DCP contributions, previously described.

Figure 3-22
Distribution of Lower Division States' Combined Shortages, DCP Contributions, and System Conservation[1]



[1] Combined shortages, DCP contributions, and system conservation does not include the effects of ICS, which contributes to the 3.0 maf of SEIS conservation and volumes vary in each hydrologic trace.

The median and maximum total modeled Lower Division State combined shortage volumes, DCP contributions, and system conservation for operating year 2024 for the No Action Alternative are both 782,718 af, and for the Proposed Action are both 1.346 maf. In 2025, the median and maximum total modeled Lower Division State combined annual shortage volumes, DCP contributions, and system conservation are 742,918 af and 1.179 maf, respectively, for the No Action Alternative, and 1.339 maf and 1.423 maf, respectively, for the Proposed Action. In 2026, the median and maximum total modeled Lower Division State combined annual shortage volumes, DCP contributions, and system conservation are 533,545 af and 1.101 maf, respectively, for the No Action Alternative, and 908,545 af and 1.476 maf, respectively, for the Proposed Action.

Combined Shortages, DCP Contributions, and System Conservation for Arizona

The median modeled combined annual shortage volumes, DCP contributions, and system conservation for Arizona under the No Action Alternative are 721,773 af in both 2024 and 2025 and decrease to 512,400 af in 2026. For the Proposed Action, the median volumes slightly decrease throughout the period and are 890,862 af, 889,862 af, and 541,400 af, respectively, reflecting a decrease in SEIS conservation throughout this period. Modeled SEIS Conservation for the Proposed Action for Arizona is listed in **Table 3-2** in **Section 3.3.5**.

Combined Shortages, DCP Contributions, and System Conservation for Nevada

Nevada does not have any modeled system conservation, therefore the modeled combined annual shortage volumes, DCP contributions, and system conservation for Nevada is the same as the modeled combined annual shortage and DCP contributions in **Figure 3-21**. Modeled SEIS Conservation in the form of ICS creation for the Proposed Action for Nevada is described in **Table 3-2** in **Section 3.3.5**. The effects of ICS are not included in **Figure 3-22** but are included in **Table 3-15** and **Figure 3-23** and described in those parts of this section.

Combined Shortages, DCP Contributions, and System Conservation for California

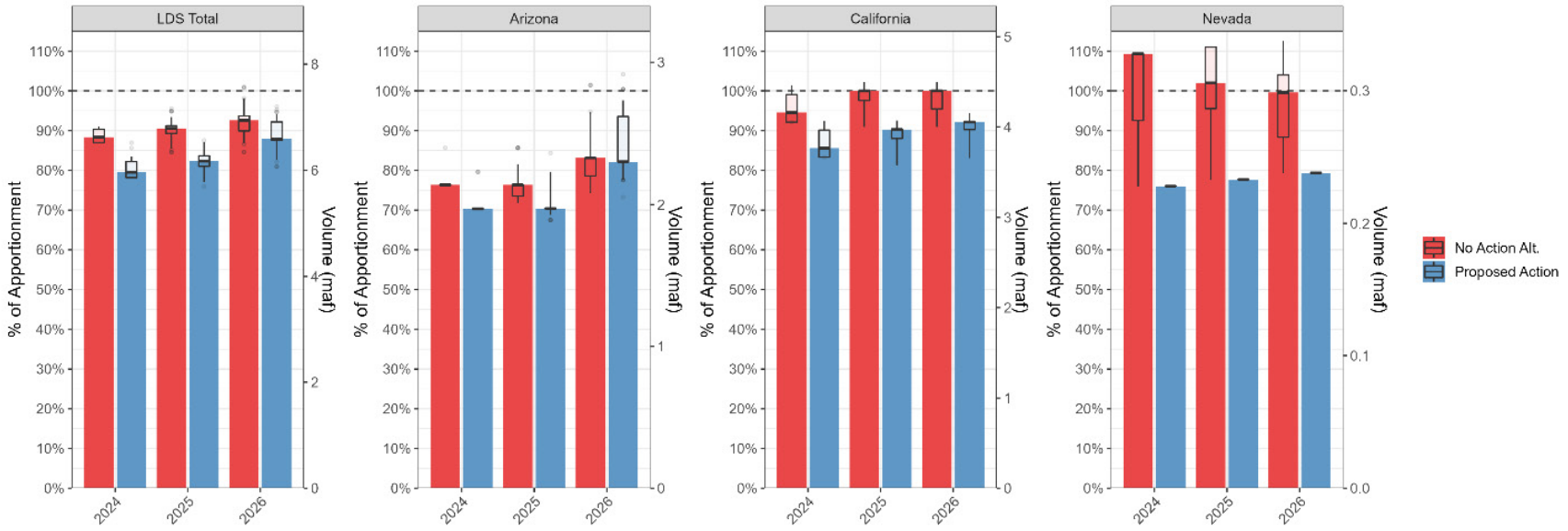
No shortages exist for California for either alternative throughout the period of analysis. The median modeled combined annual DCP contributions and system conservation for California under the No Action Alternative vary throughout the period, with volumes of 39,945 af in 2024 and 145 af in both 2025 and 2026. For the Proposed Action, the median volumes gradually decrease throughout the period, reflecting a decrease in SEIS conservation, with volumes of 434,145 af, 428,145 af, and 346,145 af, respectively. Conservation for the Proposed Action for California is in **Table 3-2** in **Section 3.3.5**.

Intentionally Created Surplus

New ICS creation contributes to the 3.0 maf of SEIS conservation in the Proposed Action, and modeling assumptions differ for how ICS is treated when the maximum volume of ICS has been accumulated[11] between the two alternatives. This section summarizes differences in the modeled ICS activity between the two alternatives.

[11] In accordance with the Lower Basin DCP, the maximum total amount of Extraordinary Conservation ICS, Binational ICS, and DCP ICS that may be accumulated by the Lower Division States is 2.7 maf.

Figure 3-23
Lower Division State Modeled Depletions



As described in **Appendix D** the ICS accumulation space sharing agreements allow states to share ICS accumulation space up to the capacity of 2.7 maf. When the maximum ICS has been accumulated, or at least one state is exceeding their maximum accumulation capacity, i.e., sharing accumulation space by using another state's space, ICS must be vacated if additional ICS is created. If a state is not using their maximum ICS accumulation space, as defined in the Lower Basin DCP, then the state that is 'sharing' their space must vacate ICS; if a state is already at their maximum accumulated ICS, and there is no accumulation space from another state to share, then that state must vacate ICS in order to create additional ICS. For the No Action Alterative, this is modeled by converting DCP-ICS to system water for all states if they need to vacate ICS space. Additionally, Nevada is modeled to take delivery of Extraordinary Conservation-ICS (EC-ICS) until they reach their maximum allowed ICS delivery at which point, EC-ICS is modeled to be converted to system water to vacate additional space (if necessary). The Proposed Action uses the same modeling assumptions as the No Action Alternative, except, if EC-ICS needs to be vacated, Nevada is modeled to convert all vacated EC-ICS to system water.

Table 3-15 shows the median modeled 2024-2026 ICS activities by state and as a Lower Division State total. For Arizona, ICS creation volumes are the same. Under the Proposed Action, there is slightly more ICS delivery modeled in Arizona because in 2026 EC-ICS is modeled to be delivered proportional to the remaining EC-ICS. Since Arizona has a lower delivery of EC-ICS in 2023 in the Proposed Action, a larger EC-ICS volume is available for delivery in 2026. For California, ICS activities are almost the same for both alternatives. The minor differences are because the Proposed Action includes additional ICS creation in 2023 (**Appendix D**), which results in a slightly smaller volume of ICS that can be created in 2024 through 2026 due to maximum ICS accumulation limits. For Nevada, the Proposed Action results in less ICS delivery, more ICS creation, and more ICS vacated to system water compared to the No Action Alternative. Since Nevada is using more than the state's individual maximum ICS accumulation, Nevada is modeled to vacate ICS so another state can create ICS. When this occurs in the No Action Alternative, it is assumed that Nevada takes delivery of Nevada's vacated ICS up to their maximum annual ICS delivery, while in the Proposed Action it is assumed that the vacated ICS is converted to system water. When combining the individual states' ICS activities, the Proposed Action has a median 397 kaf greater net positive effect on Lake Mead than the No Action Alternative.

Table 3-15
Median 2024-2026 Intentionally Created Surplus Activities

Total 2024-2026 ICS (1,000 af)*	Arizona		California		Nevada		Total Lower Division States	
	No Action Alternative	Proposed Action	No Action Alternative	Proposed Action	No Action Alternative	Proposed Action	No Action Alternative	Proposed Action
Creation	120	120	307	300	142	252	569	672
Delivery	147	161	2	2	95	0	244	163
Net Effect on Mead	-27	-41	305	298	47	252	325	509

* 2024-2026 are variable and can change with shortage conditions and ICS accumulation capacity sharing. Volumes shown in table represent the median for each alternative. In some scenarios, existing ICS water in Arizona and Nevada was modeled to be converted to system water to allow for the creation of new ICS, consistent with the Proposed Action, within ICS accumulation limitations.

Total Deliveries for the Lower Division States

Deliveries to the Lower Division States are dependent on the combined shortages, DCP contributions, and system conservation. Assumptions for ICS creation and delivery (see **Appendix D**) also affect the modeled deliveries to the Lower Division States.

Figure 3-23 shows the modeled depletions as a total for the Lower Division States and for each state in 2024, 2025, and 2026. The results are presented as a percent of apportionment and depletion volume. The median modeled values are represented by the colored bar and the mid-line in the boxplots. The boxes capture the 25th to 75th percentiles of the modeled values and the whiskers extend to the 5th and 95th percentiles, with outliers represented as dots beyond these lines.

In 2024, median Lower Division State depletions for the No Action Alternative are 6.626 maf and for the Proposed Action are 5.963 maf (**Figure 3-22**). The modeled 2025 and 2026 median total depletions for the Lower Division States are 6.791 maf and 6.946 maf under the No Action Alternative and 6.175 maf, and 6.594 maf under the Proposed Action, respectively. The total modeled depletions increase throughout the period of analysis as median combined shortages and DCP contributions remain the same, and system conservation decreases.

Modeled deliveries to the Lower Division States are lower in the Proposed Action relative to the No Action Alternative, due to the additional SEIS conservation included in the Proposed Action. Under the Proposed Action, the Lower Division States do not have depletions above their apportionment since it is assumed that Nevada converts vacated ICS to system water instead of taking delivery of the vacated ICS. However, maximum modeled combined shortages and DCP contributions are lower for the Proposed Alternative due to the impacts of SEIS conservation and resulting higher reservoir elevations in Lake Mead.

Total Deliveries to Arizona

Modeled annual depletions for Arizona are shown in **Figure 3-22**. In 2024 and 2025 under the No Action Alternative, the median modeled depletions total 2.138 maf; in 2026, the median modeled depletions total 2.328 maf. Deliveries to Arizona in the No Action Alternative increase in 2026 due to a decrease in shortages, DCP contributions, and system conservation. Under the Proposed Action, modeled water deliveries to Arizona are projected to gradually increase throughout the 3-year analysis period. This increase reflects a decrease in SEIS conservation throughout this period. In 2024–2026 under the Proposed Action, the median deliveries are 1.969 maf, 1.970 maf, and 2.301 maf, respectively. Under the Proposed Action, SEIS conservation reduces modeled deliveries to Arizona compared with the No Action Alternative. Additionally, under the Proposed Action, deliveries would likely be more reliable later in the time horizon relative to the No Action Alternative because the SEIS conservation in the Proposed Action results in higher elevations in Lake Mead.

Total Deliveries to Nevada

Modeled annual depletions for Nevada are shown in **Figure 3-22**. The trend and magnitudes of the depletions over the 3-year period differ between the alternatives. Under the No Action Alternative, water deliveries to Nevada are projected to decrease throughout the 3-year period of analysis but remain above or near full apportionment during this time. As described in **Appendix D** the ICS

accumulation space sharing agreements allow states to share ICS accumulation space up to the capacity of 2.7 maf. In 2024, the ICS accumulation space fills and Nevada is required to vacate ICS so California can create ICS up to their individual state limit (in some traces). When this occurs, it is assumed that Nevada takes delivery of their vacated ICS, which results in depletions above their apportionment in 2024 and 2025 at 328,000 af and 306,000 af, respectively, despite Nevada's combined shortages and DCP contributions. In 2026, Nevada is still modeled to vacate its ICS in many instances, but the additional ICS delivery does not exceed the combined shortages and DCP contributions, resulting in a depletion just under 100 percent of apportionment at 299,000 af.

Under the Proposed Action, water deliveries are projected to increase through the 3-year analysis period. In 2024–2026, the median deliveries are 228,000 af, 233,000 af, and 238,000 af, respectively. Under the Proposed Action, it is assumed that Nevada converts vacated ICS to system water instead of taking delivery of the volume (see **Appendix D**), resulting in significantly lower depletions than under the No Action Alternative. Deliveries under this alternative would likely be more reliable later in the time horizon relative to the No Action Alternative because the SEIS conservation in the Proposed Action results in higher elevations in Lake Mead.

Total Deliveries to California

Modeled annual depletions for California are shown in **Figure 3-22**. The deliveries to California increase from 2024 to 2026 in both alternatives. In 2024–2026 under the No Action Alternative, the median deliveries gradually increase at 4.160 maf, 4.400 maf (less than 2026 prior to rounding), and 4.400 maf, respectively, reaching its full apportionment in 2026. In 2024–2026, the ICS accumulation is at capacity, and it is assumed that Nevada takes delivery of the vacated ICS so that California can create ICS. Deliveries to California increase over this period due to a reduction in system conservation between 2024 and 2025–2026[12], and a decrease in ICS creation because of the ICS accumulation limit.

Under the Proposed Action, modeled water deliveries to California are projected to increase throughout the 3-year analysis period. This increase reflects a decrease in SEIS conservation throughout this period. In 2024–2026, the median deliveries are 3.766 maf, 3.972 maf, and 4.154 maf, respectively. Under the Proposed Action, SEIS conservation reduces modeled deliveries to California compared with the No Action Alternative and also decreases maximum modeled DCP contributions. Additionally, under the Proposed Action, deliveries would likely be more reliable later in the time horizon relative to the No Action Alternative because the SEIS conservation in the Proposed Action results in higher elevations in Lake Mead.

Protect 1,000 feet at Lake Mead

The Proposed Action includes additional guidelines through which deliveries could be affected beyond the actions already described. In the Proposed Action, if Lake Mead is projected to be below an elevation of 1,025 feet, based on the April 24-Month Study minimum probable projection, the Lower Division States, after consultation with the Upper Division States, will have 45 calendar days to provide Reclamation with an implementation plan to protect Lake Mead from reaching an

[12] While California does have modeled DCP contributions throughout the period of analysis, the DCP contributions are typically modeled to be met via conversion of existing EC-ICS, so that does not reduce the annual delivery to California shown in this issue.

elevation of 1,000 feet. Though this term was not explicitly modeled in the Proposed Action, the percent of traces that fall below Lake Mead elevations of 1,025 and 1,000 feet can be used to estimate the possibility of this occurring.

Table 3-16 summarizes the percent of traces that fall below Lake Mead elevations of 1,000 and 1,025 feet in both alternatives. The Proposed Action has 1 percent of traces below 1,025 feet in 2025 and 8 percent in 2026. While only 2 percent of traces fall below 1,000 feet in 2026, this indicates that even with the SEIS conservation in the Proposed Action, additional actions may be necessary to protect 1,000 feet at Lake Mead before the end of 2026. Such actions could impact deliveries beyond the impacts of the other actions discussed. The No Action Alternative does not include modeling assumptions to protect an elevation of 1,000 feet in Lake Mead. However, to compare against the Proposed Action, the percent of traces falling below the Lake Mead elevations is provided. In all cases there are fewer traces that fall below elevations 1,025 and 1,000 feet in the Proposed Action than in the No Action Alternative.

Table 3-16
Percent of Traces Falling Below Lake Mead Critical Elevations

Year	Percent of Traces below 1,025 feet		Percent of Traces below 1,000 feet	
	No Action Alt.	Proposed Action	No Action Alt.	Proposed Action
2024	0	0	0	0
2025	14	1	0	0
2026	23	8	4	2

Cumulative Effects

The operating tiers established by this SEIS will determine annual release volumes in the LTEMP SEIS but would result in no additional changes to water supply determinations or deliveries to Lower Division States. The LTEMP SEIS includes two elements: smallmouth bass flow options and a potential adjustment to HFE sediment account periods and implementation windows. The smallmouth bass flow options would result in temporary changes to daily and hourly flows, which would not impact the distribution of shortages. The potential adjustment to HFE sediment accounting periods and implementation windows could result in changes in the timing of HFEs, however this would result in no changes to water supply determinations or water deliveries. Therefore, no additive cumulative effects would occur on water supply determinations or water deliveries to Lower Division States due to proposed operational changes evaluated in the LTEMP SEIS.

Lastly, no additive cumulative effects would occur on water deliveries for Lower Division States due to the proposed management activities planned in the Salton Sea 10-Year Plan or the environmental assessment for the implementation of the 10-Year Plan's projects. No cumulative impacts would result as the Proposed Action is not adding additional impacts to those that are already occurring; however, these impacts might occur sooner under the Proposed Action.

Issue 4: How would changes to operational activities affect deliveries to Mexico?

As stated above, Mexico's reductions and recoverable savings are in accordance with Minute 323, with a maximum of 275,000 af (of their 1,500,000 af annual water allotment) when Lake Mead is below 1,020 feet in elevation. This differs from the assumed 16.67 percent of the total shortage analyzed in the 2007 FEIS. The amount of water modeled for delivery to Mexico during each operating year has been set in accordance with the 1944 Water Treaty and Minute 323. The alternatives in this analysis do not change the specified reductions and recoverable savings to Mexico, as outlined in Minute 323; however, the Proposed Action does affect projected Lake Mead elevations (through modeled changes to Lake Powell's release and increased Lower Division State shortages). These differences in Lake Mead's elevation can result in different modeled reductions and recoverable savings for Mexico.

Figure 3-24 shows the modeled deliveries to Mexico for the No Action Alternative and Proposed Action in 2024, 2025, and 2026. The median modeled values are represented by the mid-line in the boxplots. The boxes capture the 25th to 75th percentiles of the modeled volumes and the whiskers extend to the 5th and 95th percentiles, with outliers represented as dots beyond these lines.

Figure 3-24
Modeled Range of Deliveries to Mexico after Minute 323 Reductions and Savings

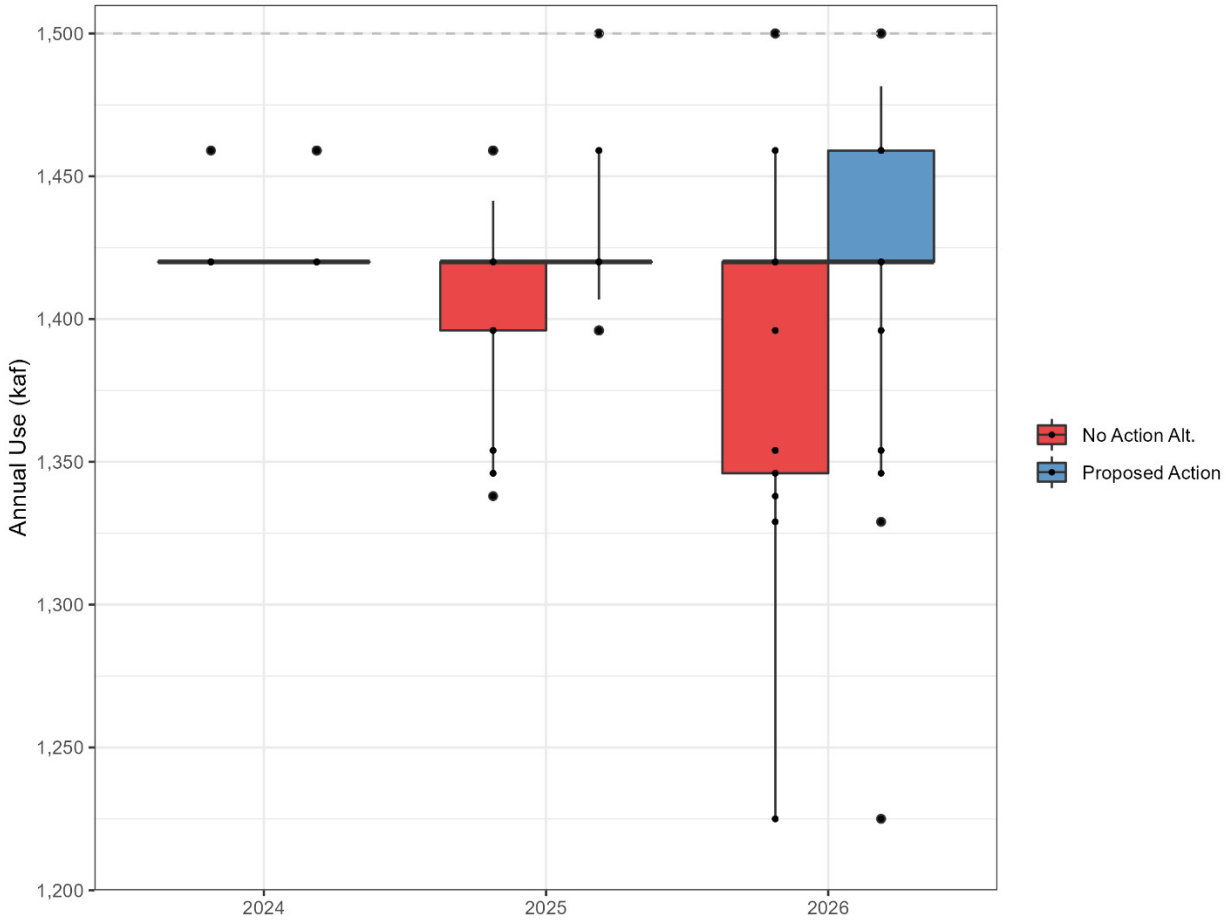


Figure 3-24 compares the modeled deliveries to Mexico for the No Action Alternative and Proposed Action. Both the No Action Alternative and Proposed Action show a median delivery to Mexico of 1.420 maf for 2024 through 2026. These deliveries are consistent with the Lake Mead elevations shown in **Figure 3-8**, which shows more consistent median elevations through 2026. Minimum modeled deliveries are lower under the No Action Alternative, consistent with lower minimum elevations at Lake Mead.

Figure 3-24 shows the modeled deliveries to Mexico for the No Action Alternative and Proposed Action in 2024, 2025, and 2026. The boxes capture the 25th to 75th percentiles of the modeled elevations and the whiskers extend to the 5th and 95th percentiles, with outliers represented as dots beyond these lines.

Cumulative Effects

The operating tiers established by this SEIS will determine annual release volumes in the LTEMP SEIS but would result in no changes to water deliveries to Mexico. The LTEMP SEIS includes two elements: smallmouth bass flow options and a potential adjustment to HFE sediment account periods and implementation windows. The smallmouth bass flow options would result in temporary changes to daily and hourly flows, which would not impact the distribution of shortages. The potential adjustment to HFE sediment accounting periods and implementation windows could result in changes in the timing of HFEs, however this would result in no changes to deliveries to the Lower Basin. Therefore, no additive cumulative effects would occur on water deliveries to Mexico due to proposed operational changes evaluated in the LTEMP SEIS.

Lastly, no additive cumulative effects would occur on water deliveries to Mexico due to the proposed management activities planned in the Salton Sea 10-Year Plan or the environmental assessment for the implementation of the 10-Year Plan's projects. No cumulative impacts would result as the Proposed Action is not adding additional impacts to those that are already occurring; however, these impacts might occur sooner under the Proposed Action.

Issue 5: How would changes to operational activities affect the modeled distribution of combined shortages and DCP contributions to and within the Lower Division States?

Summary of Alternatives

Lower Division States' shortage distributions discussed under this issue were modeled with the Shortage Allocation Model to estimate the quantity of available water to entitlement holders or water users under shortage conditions over a specified range of shortage volumes. Overall, the No Action Alternative and Proposed Action analyze the same magnitude of total shortage and DCP contributions. There is no unique Shortage Allocation Model for the Proposed Action since the distribution and priority of shortages and DCP contributions is the same as the No Action Alternative. Total Lower Division States' reduction in water delivery of up to 1.100 maf was analyzed under both alternatives. This is consistent with the 2007 Interim Guidelines shortages and 2019 DCP contributions. The distribution of these volumes is the same between the alternatives and is based on priority within each state or as provided otherwise by the 2019 DCP. Modeling details for the Shortage Allocation Model are described in **Appendix E**. While the Proposed Action considers additional volumes of system conservation, known as SEIS conservation and modeled based on the Lower Division States proposal, further discussion of SEIS conservation is not

included under this issue. For the purposes of discussion, only shortages and DCP contributions, as defined by those implemented through operational decisions, are referenced in this issue.

Under the No Action Alternative and Proposed Action, the maximum total volume of the 2007 Interim Guidelines shortages and 2019 DCP contributions is 1.1 maf, when Lake Mead is below an elevation of 1,025 feet. The maximum shortage and DCP contribution volumes for Arizona and Nevada are 720,000 af and 30,000 af, respectively. The maximum DCP contributions for California are 350,000 af. A maximum reduction in water delivery of 1.1 maf is less than 15 percent of the total Lower Division States' apportionment.

Distribution of Shortages within Arizona

Table 3-17 provides a summary of the total shortage and DCP contribution impacts modeled for Arizona, broken out by the range of analyzed shortage volumes under the No Action Alternative and Proposed Action for 2024–2026. Total basin combined shortages and DCP contributions analyzed for the Lower Division States ranged from 200,000 af to 1.1 maf. This resulted in 192,000 af to 720,000 af in reductions for Arizona, in accordance with the 2007 Interim Guidelines and 2019 DCP. As the volume of total shortage analyzed increases, there is a corresponding increase in shortages allocated to Arizona 4th-priority entitlement holders, including CAP contracts and subcontracts. (Refer to **Appendix E** for additional information.)

Distribution of Shortages within Nevada

Table 3-18 provides a summary of the total shortage and DCP contribution impacts modeled for Nevada, broken out by the range of analyzed shortage volumes under the No Action Alternative and Proposed Action for 2024–2026. Total combined shortages and DCP contributions analyzed for the Lower Division States ranged from 200,000 af to 1.1 maf. This ultimately resulted in 8,000 af to 30,000 af in reductions for Nevada, in accordance with the 2007 Interim Guidelines and 2019 DCP. There is a corresponding increase in shortages allocated to Nevada (up to 30,000 af), but only at the 8th-priority level. (Refer to **Appendix E** for additional information.)

Distribution of Shortages within California

Table 3-19 provides a summary of the total shortage and DCP contribution impacts modeled for California, broken out by the range of analyzed shortage volumes under the No Action Alternative and Proposed Action for 2024–2026. Total basin combined shortages and DCP contributions analyzed for the Lower Division States ranged from 200,000 af to 1.1 maf. This resulted in 0 af to 350,000 af in reductions for California, which are attributed to only 2019 DCP contributions. (Refer to **Appendix E** for additional information.)

Table 3-17
Shortage Impacts Modeled for Arizona by Priority

Summary of Shortage Impacts by State and Priority	Range of Analyzed Volumes of Total Shortage to Lower Division States							
Arizona – Priority	**200,000**	**533,000**	**617,000**	**867,000**	**917,000**	**967,000**	**1,017,000**	**1,100,000**
5th, 6th, and CAP Agricultural and Other Excess	192,000	294,465	335,708	338,687	338,687	338,687	338,687	330,681
4th Priority I (Mainstream)	0	0	0	0	0	0	0	18,520
4th Priority ii (CAP)[1]								
NIA Priority	0	217,535	245,633	245,633	245,633	245,633	245,633	245,633
M&I Priority	0	0	0	32,302	32,302	32,302	32,302	80,877
Indian Priority	0	0	10,659	23,378	23,378	23,378	23,378	44,289
2nd and 3rd Priorities	0	0	0	0	0	0	0	0
1st Priority (PPR)	0	0	0	0	0	0	0	0
Subtotal	**192,000**	**512,000**	**592,000**	**640,000**	**640,000**	**640,000**	**640,000**	**720,000**

Note: This analysis does not reflect an operational estimate of when water may cease to be physically available to certain users.
Note: Orange highlights indicate the level at which available water for a priority is reduced to zero.
Note: Refer to **Appendix E**, Shortage Allocation Model Documentation, for additional information.
[1]Water for AZ P5 (unused) and P6 (surplus) contracts is not available during shortage and for the purposes of this analysis, these contracts are assumed not to be fulfilled. CAP agricultural and other excess contracts do not confer a Colorado River water entitlement and cannot be exercised under any of the scenarios modeled here.

Disclaimer: These modeling results for the No Action Alternative should only be used to compare the relative magnitude of effects reasonably expected to occur under the alternatives evaluated in this SEIS. Modeling assumptions should not be taken as agency position with respect to contract or statutory interpretation. The modeling assumptions are not intended to limit Secretarial discretion with respect to current or future policy. This model is not a substitute for the annual process of reviewing water orders and determining which can be filled, and it cannot replicate the precision required of that process.

Table 3-18
Shortage Impacts Modeled for Nevada by Priority

Summary of Shortage Impacts by State and Priority	Range of Analyzed Volumes of Total Shortage to Lower Division States							
Nevada – Priority	**200,000**	**533,000**	**617,000**	**867,000**	**917,000**	**967,000**	**1,017,000**	**1,100,000**
8th Priority (SNWA—Balance and Unused)	8,000	21,000	25,000	27,000	27,000	27,000	27,000	30,000
8th Priority (SNWA and Big Bend)	0	0	0	0	0	0	0	0
7th Priority (Boy Scouts, Reclamation, and Nevada Department of Wildlife)	0	0	0	0	0	0	0	0
6th Priority (Las Vegas Valley Water District)	0	0	0	0	0	0	0	0
5th Priority (PABCO and Lakeview Company)	0	0	0	0	0	0	0	0
4th Priority (Henderson and Basic Management)	0	0	0	0	0	0	0	0
3rd Priority (Boulder City)	0	0	0	0	0	0	0	0
2nd Priority (LMNRA)	0	0	0	0	0	0	0	0
1st Priority (PPRs: LMNRA and Fort Mojave Indian Reservation)	0	0	0	0	0	0	0	0
Subtotal	**8,000**	**21,000**	**25,000**	**27,000**	**27,000**	**27,000**	**27,000**	**30,000**

Note: This analysis does not reflect an operational estimate of when water may cease to be physically available to certain users.
Note: Refer to **Appendix E**, Shortage Allocation Model Documentation, for additional information.

Disclaimer: These modeling results for the No Action Alternative should only be used to compare the relative magnitude of effects reasonably expected to occur under the alternatives evaluated in this SEIS. Modeling assumptions should not be taken as agency position with respect to contract or statutory interpretation. The modeling assumptions are not intended to limit Secretarial discretion with respect to current or future policy. This model is not a substitute for the annual process of reviewing water orders and determining which can be filled, and they cannot replicate the precision required of that process.

Table 3-19
Shortage Impacts Modeled for California by Priority

Summary of Shortage Impacts by State and Priority	Range of Analyzed Volumes of Total Shortage to Lower Division States							
California—Priority	**200,000**	**533,000**	**617,000**	**867,000**	**917,000**	**967,000**	**1,017,000**	**1,100,000**
4th Priority (MWD)	0	0	0	186,000	232,500	279,000	325,500	325,500
3rd Priority (IID, CVWD, Palo Verde Irrigation District)	0	0	0	14,000	17,500	21,000	24,500	24,500
2nd Priority (Yuma Project Reservation Division)	0	0	0	0	0	0	0	0
1st Priority (Palo Verde Irrigation District)	0	0	0	0	0	0	0	0
PPRs	0	0	0	0	0	0	0	0
Subtotal	**0**	**0**	**0**	**200,000**	**250,000**	**300,000**	**350,000**	**350,000**

Note: This analysis does not reflect an operational estimate of when water may cease to be physically available to certain users.
Note: Refer to **Appendix E**, Shortage Allocation Model Documentation, for additional information.

Disclaimer: These modeling results for the No Action Alternative should only be used to compare the relative magnitude of effects reasonably expected to occur under the alternatives evaluated in this SEIS. Modeling assumptions should not be taken as agency position with respect to contract or statutory interpretation. The modeling assumptions are not intended to limit Secretarial discretion with respect to current or future policy. This model is not a substitute for the annual process of reviewing water orders and determining which can be filled, and they cannot replicate the precision required of that process.

Cumulative Effects

The operating tiers established by this SEIS will determine annual release volumes in the LTEMP SEIS. The LTEMP SEIS includes two elements: smallmouth bass flow options and a potential adjustment to HFE sediment account periods and implementation windows. The smallmouth bass flow options would result in temporary changes to daily and hourly flows, which would not impact the distribution of shortages. The potential adjustment to HFE sediment accounting periods and implementation windows could result in changes in the timing of HFEs, however this would result in no changes to the distribution of shortages. Therefore, no additive cumulative effects would occur on water deliveries to Lower Division States due to proposed operational changes evaluated in the LTEMP SEIS.

Lastly, no additive cumulative effects would occur on water deliveries for Lower Division States due to the proposed management activities planned in the Salton Sea 10-Year Plan or the environmental assessment for the implementation of the 10-Year Plan's projects. No cumulative impacts would result as the Proposed Action is not adding additional impacts to those that are already occurring; however, these impacts might occur sooner under the Proposed Action.

Issue 6: How would changes to operational activities affect flows into the Salton Sea?

Summary of Alternatives

As noted above, the Salton Sea receives flows from the surrounding watershed and excess irrigation drainage from the IID and CVWD. Under the No Action Alternative, there would be no changes to current operational activities that would affect flows to the IID or CVWD. Therefore, the surface water elevation of the Salton Sea could continue to decrease at the current rate. Under the Proposed Action, there is the possibility that the IID and CVWD could enter into additional system conservation agreements; thus, there could be reduced deliveries, resulting in potentially less inflow to the Salton Sea from irrigation drainage. Therefore, the Proposed Action could result in expedited (but not additional) lakebed exposure compared with the No Action Alternative, due to less possible available agricultural runoff. Lakebed exposure may be greater under the Proposed Action for the next 26 years, as estimated by the Salton Sea Modeling (Tetra Tech 2023), but long-term impacts would be the same as under the No Action Alternative.

3.8 Water Quality

3.8.1 Affected Environment

This section describes the water quality constituents that could be affected by the alternatives. These water quality constituents of concern are:

- Salinity
- Temperature
- Sediment
- Nutrients and algae
- Dissolved oxygen

- Metals
- Perchlorate

This section describes historical and existing condition changes that have occurred since the 2007 FEIS was published. (For more information on the water quality constituents and historical conditions prior to 2007, refer to the 2007 FEIS.) While other water quality-related issues and parameters were also considered, they were determined unlikely to be affected by the alternatives, or there was insufficient data to provide an assessment; therefore, they are not discussed here.

Salinity

Historically, salinity has been a concern for the Basin. High salinity causes damage across agricultural, municipal, and industrial sectors in the US, and it negatively impacts municipal and agricultural users in Mexico (USGS 2021). (See the 2007 FEIS for more information.)

The salinity criteria for the Colorado River have not been updated since the 2007 FEIS was published. The Colorado River Basin Salinity Control Forum continues to review and make salinity criteria recommendations for the Colorado River every 3 years (Colorado River Basin Salinity Control Forum 2020). **Table 3-20** shows the current salinity criteria for the Colorado River.

Table 3-20
Salinity Criteria for the Colorado River

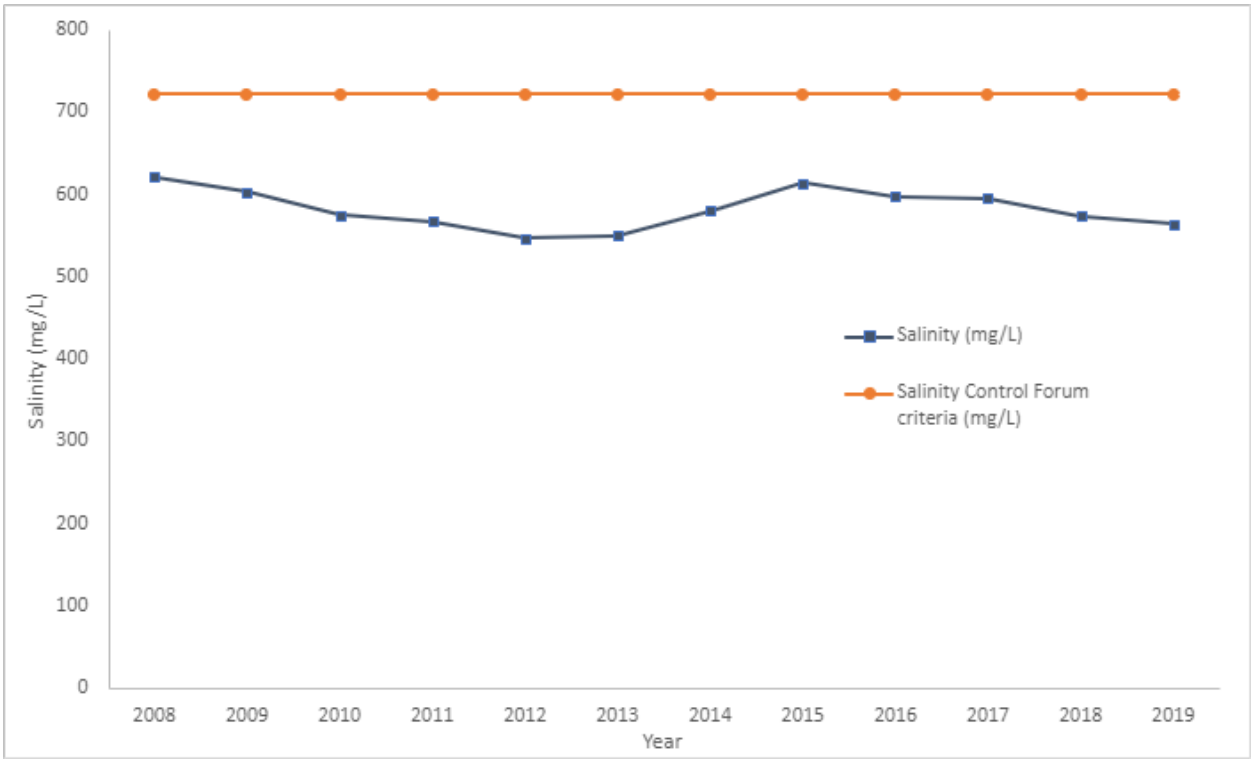
Station	Flow-weighted average annual salinity (mg/L)
Below Hoover Dam	723
Below Parker Dam	747
At Imperial Dam	879

Source: Colorado River Salinity Control Forum 2020

While salinity in the Colorado River has generally decreased over the past century (USGS 2021), salinity has only slightly decreased since 2007. Implementing measures on private agricultural and federal lands produce salinity control results. Programs like the Basin States Program and the US Department of Agriculture's Environmental Quality Incentives Program provide cost-share assistance to landowners who install salinity control measures (Reclamation 2022d). Despite these salinity control efforts, there has been a consistent slowing of downward trends since 2000 (Rumsey 2021).

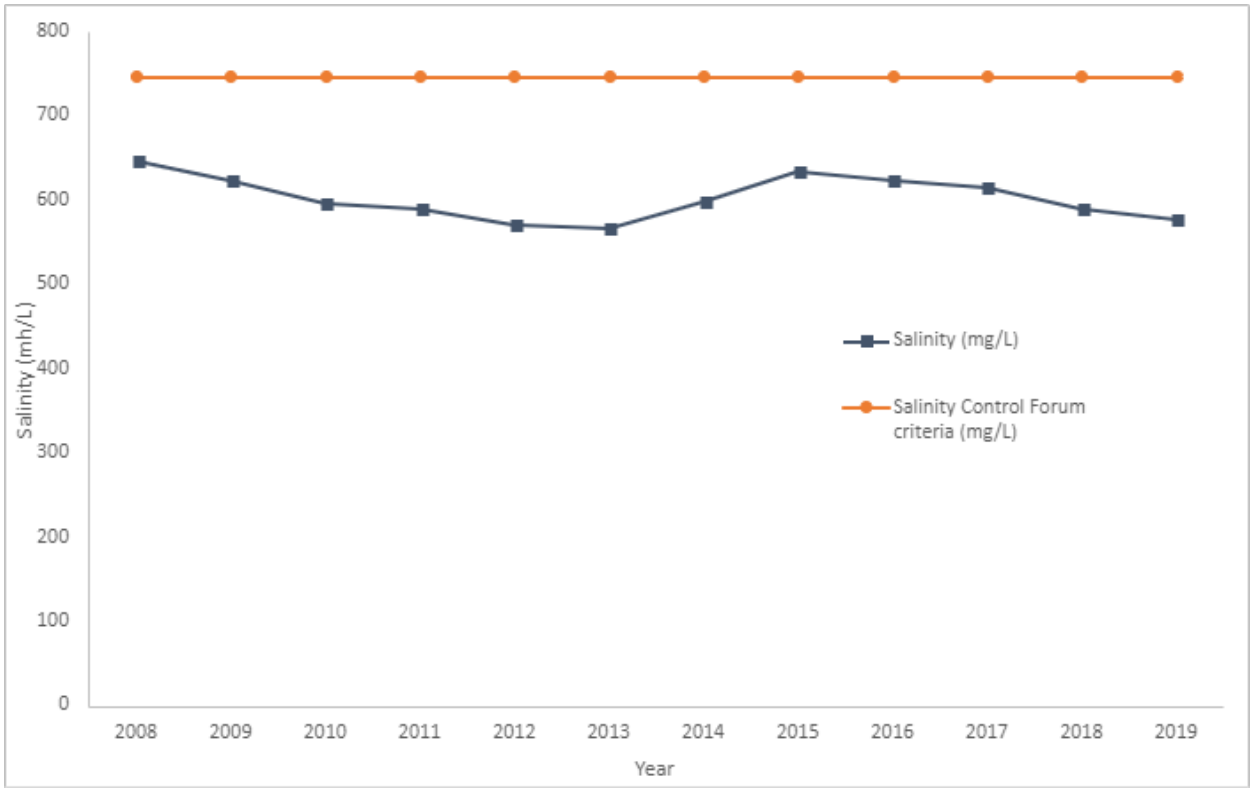
When the 2007 FEIS was released, salinity downstream of Glen Canyon Dam varied between 390 and 660 milligrams per liter (mg/L); more recently, salinity has varied between 300 and 600 mg/L (Reclamation and NPS 2016). It is important to note that releases from lower elevations in Lake Powell through the river outlet works are cooler and more saline compared with releases from higher elevations through the penstocks of Glen Canyon Dam (Reclamation and NPS 2016). In a review of sampling efforts from 2007–2019, Reclamation has not exceeded the salinity criteria for the Colorado River, which are described in **Table 3-20**. At the time of this report, data were not available after 2019 (Reclamation 2019b). (See **Figure 3-25**, **Figure 3-26**, and **Figure 3-27** for more information and historical salinity concentrations in the Lower Basin.)

Figure 3-25
Colorado River Salinity Concentrations and Flows Downstream of Hoover Dam 2008–2019



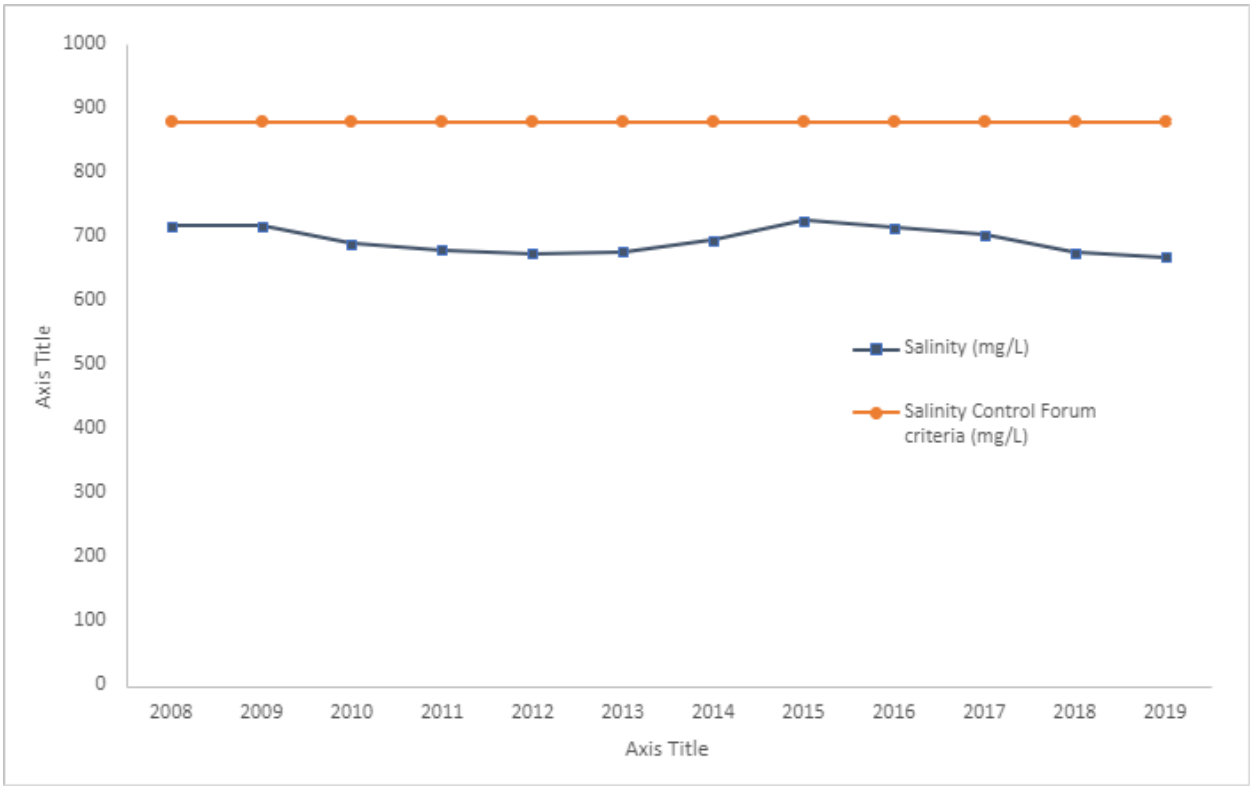
Source: Colorado River Basin Salinity Control Forum 2020

Figure 3-26
Colorado River Salinity Concentrations and Flows Downstream of Parker Dam 2007–2019



Source: Colorado River Basin Salinity Control Forum 2020

Figure 3-27
Colorado River Salinity Concentrations and Flows at Imperial Dam 2007–2019



Source: Colorado River Basin Salinity Control Forum 2020

Temperature

Since the early 2000s, drought conditions and lower water levels in Lake Powell have led to a general warming of water temperatures in the Colorado River below Glen Canyon Dam (Reclamation and NPS 2016). Temperatures in the Colorado River in the Grand Canyon are highly variable over space and time and are primarily controlled by the discharge and temperature released from Glen Canyon Dam and solar radiation dynamics along the river corridor (Mihalevich et al. 2020). As water moves farther away from Glen Canyon Dam (for example, below river mile [RM] 88), the influence of release discharges and temperature on water temperature becomes less, and local meteorological conditions become more important in determining the heat budget.

During summer periods, increases in water temperatures downstream of Glen Canyon Dam are attributed to solar radiation and air temperatures (Dibble et al. 2021). The water in the Colorado River generally warms 1˚C (33.8˚F) for every 30 miles traveled downstream during warmer months of the year under specific discharge and meteorological conditions. Some variation in lateral warming also occurs, with warmer temperatures along the shoreline and cooler water in the deep, fast-moving areas (Reclamation and NPS 2016).

Lake Powell is thermally stratified through much of the spring, summer, and early fall; this means Lake Powell is arranged into layers with distinct temperatures and chemical characteristics. Generally, Lake Powell's epilimnion, or uppermost layer, ranges from 25˚ to 30˚C (77˚ to 86˚F) in

the summer and may drop to 6°–10°C (42.8°–50°F) in the winter. Lake Powell's hypolimnion, or deeper layer, ranges from 6° to 9°C (42.8° to 48.2°F). Lake Powell experiences relatively homogenous temperatures throughout the water column. In the winter, the thermal stratification breaks down, and Lake Powell experiences turnover where the different layers mix to create relatively homogenous conditions throughout the water column (Reclamation and NPS 2016). Full turnover does not occur every year, but partial turnover does.

Lake Mead is also thermally stratified. The temperature that enters Lake Mead is a function of Glen Canyon Dam discharges and downstream meteorological conditions (Reclamation and NPS 2016). Lake Mead's hypolimnion, or deepest layer, is around 12°C (53.6°F) year-round. Lake Mead's epilimnion, or uppermost layer, ranges from about 14° to 29°C (57.2° to 84.2°F) in the spring, summer, and early fall, then drops to about 13°–15°C (55.4°–59°F) in the winter (SNWA 2023). (For additional historical data, see the 2007 FEIS.)

Sediment

Sediments, as considered in this analysis, are those that are sand sized (0.06 to 2.0 millimeters) or smaller. High concentrations of fine suspended sediment (less than 0.06 millimeters) can increase turbidity (cloudiness), a water quality measure that affects light penetration and photosynthesis for aquatic species. (See **Section 3.13.2**, Biological Resources Environmental Consequences, for a description of the effects of turbidity on fish.)

Downstream of Hoover Dam, infrequent sediment inputs from the Bill Williams River and the Gila River cause sediment loading and increased turbidity. Reclamation continues to implement dredging projects upstream of Imperial and Laguna Dams to remove accumulated sediment and ensure efficient delivery of Colorado River water to downstream users (Reclamation 2021b; USGS 2022).

Sediment in the reach from Lake Powell to Lake Mead depends on a mass balance between sediment deposition, erosion, and storage. Sediment deposition occurs wherever there is more sediment influx than efflux (Grams et al. 2013). Sediment storage is a dynamic condition that varies based on the specific spatial and temporal scales considered; it can be increasing (net deposition), decreasing (net erosion), or at equilibrium.

Sand is deposited throughout the reach between Lake Powell and Lake Mead (in the Marble and Grand Canyons) in bars (or patches) on the riverbed, in eddies, and on terrace sandbars (Reclamation and NPS 2016). Sandbars and beaches are important for biological, cultural, and recreational resources along the Colorado River. They form the substrate for the limited riparian vegetation in the arid environment (Hazel et al. 2022). Low-elevation sandbars create zones of low-velocity aquatic habitat (backwaters) that juvenile native fish utilize (Grams et al. 2010). These low-elevation sandbars are also a source of sand for aeolian (wind) transport. Under National Park Service and LTEMP goals, these areas are managed to reduce vegetation to a more natural and bare condition that enables dunes to migrate upslope, help protect archaeological resources (Sankey et al. 2022), and rebuild camping beaches for river and backcountry users (Hazel et al. 2022).

Sandbars (including beaches) continuously exchange sand with the Colorado River. Thus, the sandbars commonly found along the banks of the Colorado River are generally dynamic and

unstable. Since 1996, Reclamation has continued to conduct HFE releases to manage limited sediment resources to maintain or increase sandbar size. HFEs are experiments designed to improve sediment deposition, in which water releases from Glen Canyon Dam are much larger than the base flow that is typically released. HFEs are the only existing mechanism for producing river stages high enough to contribute to significant sandbar building. As regulated under LTEMP, Reclamation uses two 6-month sediment accounting windows, or periods (one during the fall and one during the spring). These are used to evaluate whether the sediment mass balance is optimal for sandbar building prior to HFE implementation. HFE releases between 34,000 and 37,000 cfs (or greater) are necessary for sandbar deposition (increased sandbar size); generally, sandbars erode between HFEs (Hazel et al. 2022).

After the most recent HFE was completed in April 2023, reservoir balancing during July and August 2023 resulted in sustained high releases and net sediment export. This has effectively reduced the probability of triggering another HFE between November 2023 and April 2024.

Long-term rehabilitation of sandbars is only possible if the increases in sand volume caused by HFEs exceed the erosion during intervening operational flow periods (Schmidt and Grams 2011). This is why frequent HFEs were designed under the LTEMP protocol and why frequent HFEs are needed to allow for net building versus net erosion. This is also why high flows, such as equalization flows, should be avoided between HFEs.

River stage also affects the area of sand available for aeolian transport, as lower flows expose larger areas of bare sediment that can be mobilized by wind. Once sand has been exposed (not inundated) for a period of 3 consecutive days, that sand is approximately as mobile as the sand that was not previously inundated (Sankey et al. 2022).

Turbidity is known to increase in this reach during large sediment inputs from tributaries, such as the Paria River (USGS 2016), and during HFEs (Voichick and Topping 2010). As analyzed in the LTEMP FEIS, turbidity increases from erosion during HFEs are temporary; any observed fluctuations recover quickly when flows return to those less than flows of an HFE magnitude (Reclamation and NPS 2016). These trends would continue under both alternatives.

Nutrients and Algae

The 2007 FEIS describes how deeper or hypolimnetic releases from Glen Canyon Dam are relatively nutrient rich, whereas epilimnetic, or higher releases, may reduce nutrients available to downstream ecosystems. Nutrients, like nitrogen and phosphorus, are necessary for healthy aquatic ecosystems, but high levels of nutrients can cause algal blooms and poor water quality, threatening drinking water quality and harming aquatic life. Releases from Glen Canyon Dam and downstream Colorado River waters are generally low in nutrients (for example, the Glen Canyon Dam releases average 0.005 mg/L; Deemer et al. 2023). However, inflows from tributaries typically contain warmer, nutrient-rich water that mixes with the Colorado River (Reclamation and NPS 2016).

Total phosphorus samples at Lake Mead typically range from undetectable to 3.9 mg/L (SNWA 2023). In Lake Mead, water within the Las Vegas Bay has the highest concentration of nutrients due to the discharge of wastewater effluent from the Las Vegas metropolitan area. Wastewater is a

persistent contributor to the phosphorus needed to sustain algal growth, and stormwater with higher phosphorus contributions is an acute contributor. Since phosphorus is a limiting nutrient in the Colorado River system, these contributions support algal growth (USGS 2012). Additionally, lowering reservoir levels generally increases the concentration of nutrients and temperature levels, especially in shallow areas, which are more favorable for algal growth.

In Lake Mead in 2015, increases in the temperatures of water entering Lake Mead led to a harmful algal bloom caused by a cyanobacteria, *Microcystis*, which can produce toxins harmful to humans, pets, and wildlife (Reclamation and NPS 2016). (See **Section 3.14**, Recreation, for information about harmful algal blooms' impacts on recreation.)

No new total maximum daily loads have been issued or evaluated for total phosphorus or ammonia in the Las Vegas Wash since the 2007 FEIS was published.

Dissolved Oxygen

Dissolved oxygen (DO) levels in Lake Powell and the Glen Canyon Dam tailwaters[13] have been low compared with historical DO levels. This is due to a combination of low reservoir elevations and high inflows in recent years. Resuspended sediments at the inflow areas cause low DO plumes; this is because that suspended sediment creates high biological and chemical oxygen demand (that is, bacteria and other biota consuming oxygen, and chemical reactions consuming oxygen). This problem is exacerbated whenever large sediment inputs occur, especially when sediment erodes from the reservoir banks in the springtime. Also, during low lake elevations, more bed-cutting and bank erosion occur. Under low lake elevations, the residency time in Lake Powell is shorter for the low DO plumes, and the low DO water appears at Glen Canyon Dam sooner than it would under higher starting lake elevations.

The low DO condition resolves downstream of the Paria Riffle and Badger Rapids as the water is reaerated through whitewater action. The Colorado River DO increases approximately 1 mg/L between Glen Canyon Dam and Lees Ferry. This approximation can vary between negligible re-oxygenation and approximately 3 mg/L increases during very low oxygen releases during daylight hours (GCMRC 2023). DO levels below Glen Canyon Dam vary throughout the year, starting as low as 2.2 mg/L in the summer and fall and rising as high as 9 to 10 mg/L in the spring (GCMRC 2023). This seasonal variation is due to changes in DO at the penstock level of Lake Powell during the year. In recent years, periods of low DO (less than 5 mg/L) have become more common due to the age of the reservoir and more volume of deltaic sediment available to be remobilized.

Generally, Lake Powell DO concentrations are at their highest in the spring to early summer, when inflows are well oxygenated and wind-induced mixing are high. Low DO concentrations move through the reservoir and closer to the dam during the summer into the fall because of organic matter decomposition and chemical reactions that consume oxygen. DO gradually increases in the winter as a result of the higher oxygen-carrying capacity of cold water and the natural mixing processes that occur during turnover. Notably, when water is discharged through the river outlet

[13] Tailwater is the water below the reservoir that would be more similar to reservoir waters than downstream waters.

works, such as during HFEs or the flow options evaluated here, it becomes well-aerated and increases the DO levels in the tailwaters—but only as long as the river outlet works are open.

In Lake Mead, DO levels decrease in the bottom of the Las Vegas Basin as a result of high decomposition rates. Living algae in surface waters produce oxygen, then oxygen is consumed when the algae are decomposed in bottom waters. When greater nutrients and algae exist in surface water, more decomposition and low oxygen occur in bottom waters, assuming a stratified system. Ongoing monitoring and investigations are being conducted to determine the cause of decreased DO concentrations in isolated sections, but the driver is likely higher temperatures from inflows. Backwaters in embayments have little water exchange and tend to be shallower and warmer. These conditions increase the likelihood of algae blooms and issues with low DO conditions, or hypoxia, when the algae die (Reclamation and NPS 2016). (See **Section 3.13**, Biological Resources, for information about algal blooms' effects on wildlife.)

Metals

The 2007 FEIS describes the sources of various metals, including selenium and mercury, within the planning area. Selenium and mercury are toxic to fish and wildlife and can accumulate in the food web (Walters 2015). The Environmental Protection Agency's (EPA's) drinking water maximum contaminant level (MCL) for mercury has not been updated since the 2007 FEIS; the MCL is 0.002 mg/L. The Lower Basin's selenium standard is 0.002 mg/L. The selenium in the Colorado River is about 0.001 mg/L greater than the standard. There have been no significant changes to selenium or mercury since the 2007 FEIS was published.

The 2007 FEIS also describes the soluble hexavalent chromium detected in groundwater in two known locations in the Lower Basin: at the former McCulloch Manufacturing Plant in Lake Havasu City, Arizona, and at the Pacific Gas and Electric Compressor Station near Needles, California. Since 2007, mitigation efforts and plume monitoring have been ongoing. The latest groundwater monitoring data indicate that plume migration is not occurring (California Water Boards 2022). The landowner continues to monitor the chromium associated with the former McCulloch Manufacturing Plant at Lake Havasu and Holly Avenues. Based on the latest site investigations, the groundwater chromium plume extended approximately 3,000 feet long and about 600 feet wide from the former McCulloch facility. This remained within the vicinity of the former McCulloch facility, which is several thousand feet from the Colorado River (Arizona Department of Environmental Quality 2022).

Under lower lake elevations in Lake Powell, turbidity currents reaching the dam outtake have been observed. There is uncertainty about whether any of this turbidity contains metals from deltaic sediments, such as from past mining spills (USGS 2018).

Perchlorate

The 2007 FEIS describes the perchlorate contamination linked to a groundwater plume from the Kerr McGee Chemical Company in Henderson, Nevada. Since 2007, mitigating the perchlorate contamination has been an ongoing effort. The Nevada Division of Environmental Protection and the SNWA show a decreasing trend in perchlorate concentrations over the last decade, especially after point source remediation efforts began in 2002 (Hannoun and Tietjen 2022).

Salton Sea

As stated in **Section 3.3.6**, the Salton Sea receives runoff from its surrounding watershed (not the Colorado River Basin) and agricultural runoff that originates in the Colorado River Basin (deliveries) (USGS 2023b; see **Section 3.7**, Water Deliveries, for more information). The primary source of inflow to the Salton Sea is irrigation return water. As irrigation return water decreases, salinity increases as the Salton Sea's water evaporation concentrates dissolves salts and dilution by inflows with lower salinity decreases. The Salton Sea is a high-salinity body of water where some ponds have higher salinity than ocean water.

A main source of selenium for the Salton Sea is the Colorado River water due to evaporation and evapotranspiration in agricultural fields and from leaching of selenium from irrigated farmland soils from Colorado River allocations (USGS 2023b). Sediment is introduced to the Salton Sea by irrigation return water; drain management practices, such as dredging and bank stability; and natural channel scouring and bank erosion (California Water Boards 2002).

3.8.2 Environmental Consequences

Methodology

Salinity and Temperature

To understand the drivers of water quality changes in Lake Powell, a two-dimensional hydrodynamic model has been developed using the CE-QUAL-W2 model (Williams 2007) for salinity and total dissolved solids (TDS). Salinity is the measure of the amount of dissolved salt in water, where TDS measures all dissolved solids in a water sample. TDS is a similar constituent because it estimates the level of salt within a water sample. TDS was used in the CE-QUAL-W2 model as a proxy for salinity. CE-QUAL-W2 uses hydrologic and weather information to calculate the individual heat and constituent fluxes that contribute to reservoir mixing and stratification. To do this accurately, high-quality weather and hydrologic information are needed. Additionally, high-quality bathymetric data are needed to build the model grid.

Currently, the Lake Powell model is being redeveloped using updated bathymetric information (Jones and Root 2021). At the time of this modeling, the "new" version has only been tested for temperature and TDS fluxes; it was still being calibrated for other constituents. Lake Powell modeling for this SEIS uses this new version and only simulates temperature and TDS within the reservoir. Unlike CRSS used in 2007, CRMMS does not include a module for salinity.

The two primary inflows to Lake Powell are the Colorado and San Juan Rivers. Additional inflows from minor tributaries to Lake Powell exist; however, Reclamation's CRMMS did not model these minor tributaries. For this study, inflows from minor tributaries were assumed to be negligible influences on temperature and TDS predictions. CE-QUAL-W2 model simulations require higher spatial and temporal resolution data than what CRMMS provides. To achieve higher resolution flow information, total monthly inflow volumes were downscaled using daily flow data from 1991 to 2022 at four long-term US Geological Survey (USGS) gage sites: Colorado River near Cisco, Utah (09180500); Green River at Green River, Utah (09315000); San Rafael River near Green River, Utah (09328500); and San Juan River near Bluff, Utah (09379500). Note that the total inflows from the

Colorado River to Lake Powell are the summation volumes from the Cisco, Utah; Green River at Green River, Utah; and San Rafael River near Green River, Utah gages.

The average proportion of flow from these four gages between 1991 and 2022 was used to divide CRMMS total inflows among these sources. Daily inflows from each gage were resampled to match the same historical year used in the creation of the Ensemble Streamflow Prediction (ESP). Finally, flow volumes from each gage were adjusted proportionally to match the forecasted volumes from CRMMS.

Inflow temperatures to Lake Powell were reconstructed from historical daily water temperature data. Daily temperature information from 1991 to 2022 was obtained for each of the four gages. For each gage, data gaps were filled using the day-of-year average temperature. Like daily inflows, temperatures from each gage were resampled to match the same historical year used in the creation of the ESP.

A daily record of TDS concentrations at the four long-term USGS gage sites was reconstructed and used for inflow discharge. For days with no conductivity measurement, the Weighted Regressions on Time Discharge and Season models with a Kalman filter were used (Zhang and Hirsch 2019). Recommendations that there would be at least 200 concentration values spanning a period of at least a decade were used. For most tributaries, this was met using data from the hydrologic reconstruction time frame (1991–2021); however, 1985–2022 data were used for the San Rafael to incorporate at least 200 concentration values in the model. The hydrologic trace information for total Lake Powell inflows at the monthly timestep were proportioned among the four gages modeled.

A total of 120 traces were simulated in CE-QUAL-W2 for Lake Powell, including all 30 traces from the No Action 80 percent ESP, No Action 100 percent ESP, Proposed Action 80 percent ESP, and Proposed Action 100 percent ESP ensembles. Traces that most closely represent the 10th, 50th, and 90th quantiles of the projection were from the No Action Alternative and Proposed Action. Closest traces were determined by selecting the trace that resulted in the lowest root mean squared error between each trace elevation time series and the 10th, 50th, and 90th quantile elevation time series.

A two-dimensional hydrodynamic and water quality model of Lake Mead was originally developed to simulate temperature and TDS using CE-QUAL-W2 (Cole and Wells 2021) by the Upper Colorado Region of the Reclamation in 2011; several updates were made through 2018. In 2019, Hydros performed an evaluation of input development and model performance (Hydros 2019), and subsequently refined and recalibrated the model (Hydros 2020). Hydros currently runs the improved Lake Mead W2 model on a quarterly basis to provide a 24-month forecast of salinity in releases from Hoover Dam. These results are then used as inputs to additional models that forecast salinity in the Colorado River from Hoover Dam to the NIB with Mexico. The refinement, recalibration, and application of the Lake Mead W2 model is described in detail in Hydros 2020.

The Colorado River is the primary inflow to Lake Mead, with smaller contributions from the Virgin River, Muddy River, and Las Vegas Wash. As modeled by Reclamation's CRMMS, inflow to Lake Mead includes the Colorado, Virgin, and Muddy Rivers. CRMMS information received included total monthly inflow values for these three tributaries. Because the Lake Mead W2 model requires

separate flows to be specified for each source at a daily—rather than monthly—resolution, the following steps were taken to disaggregate CRMMS total flow:

1. Monthly side inflow (Virgin River, Muddy River, and gains/losses in the Colorado River below Lake Powell) was estimated as the difference between CRMMS-output inflow to Lake Mead and Lake Powell releases.
2. Daily flow time series were constructed for the Virgin and Muddy Rivers using measured flows[14] from 2009 and scaling based on the ratio of CRMMS monthly side inflows to observed monthly side inflows for 2009.
3. Daily flow time series were constructed for the Colorado River using measured flows[15] from the years corresponding to each trace period (see below) and scaling based on the ratio of CRMMS monthly inflows to Lake Mead, less the estimated Virgin/Muddy River inflow, to observed monthly historical Colorado River flows.
4. Monthly gains and losses in the Colorado River between Lake Powell and Lake Mead were estimated as the difference between estimated Colorado River inflow and Lake Powell outflow.

Las Vegas Wash flows were assumed to be equal to historical observations[16] corresponding to the trace period when available,[17] and estimated as total observed return flow on a monthly basis when observations were not available.

While the exact distribution of inflows among the four main tributaries varied slightly among scenarios, the Colorado River represented the majority of inflow (approximately 97 percent) to Lake Mead in all scenarios.

Inflow temperatures for each major Lake Mead inflow were estimated using regression equations that use air temperature from the selected meteorology and the forecasted daily flow rates. For the Colorado River, the temperature regression also includes water temperatures predicted at Glen Canyon Dam by the Lake Powell W2 model and air temperatures recorded at Page, Arizona.

For the Colorado River Lake Mead inflow, projected inflow TDS values were estimated using a regression equation based on TDS outputs from the Lake Powell model, as well as forecasted outflow from Lake Powell and inflow to Lake Mead. Virgin River TDS concentrations were estimated using the USGS SLOAD Flow-TDS regression model and forecasted flows. For the Muddy River and Las Vegas Wash, the inflow TDS was projected based on regression equations using the forecasted flows for each tributary.

The Lake Mead W2 model was run for three traces under the No Action Alternative and Proposed Action. For each alternative, three hydrologic traces were identified (out of 90 traces per alternative) that represented the 10th, 50th, and 90th percentile of projected storage in Lake Mead under that alternative. The appropriate traces were identified by calculating the percentile of storage (such as

[14] Virgin River near Overton, USGS 09415250; Muddy River at Overton, USGS 09419507
[15] Colorado River near Diamond Creek, USGS 09404200
[16] Las Vegas Wash below Las Vegas, Boulder City, USGS 09419800
[17] Flow observations available 2002–2022

10th percentile) for each month across the 90 traces for that alternative to develop a time series of the percentile of storage, then selecting the trace with the lowest root mean squared error when compared with the percentile time series. This resulted in six unique scenarios using four different hydrologic traces (**Table 3-21**). For each trace simulated with the Lake Mead W2 model, simulated results from the Lake Powell W2 model for the corresponding trace were used to generate the input temperature and TDS time series for the Colorado River, as described above.

Table 3-21
Selected Traces for Each Management Alternative

Selected Trace	Reasoning
1995 80 percent ESP	50th percentile of projected storage in Lake Mead for the No Action Alternative
2013 80 percent ESP	10th percentile of projected storage in Lake Mead for the No Action Alternative and Proposed Action
2013 100 percent ESP	90th percentile of projected storage in Lake Mead for the No Action Alternative and Proposed Action
2017 100 percent ESP	50th percentile of projected storage in Lake Mead for the Proposed Action

Note that the hydrologic traces for the 10th and 90th percentiles of storage are the same for both the No Action Alternative and the Proposed Action (**Table 3-21**). This means that differences in the simulated TDS and temperatures between the management scenarios at relatively high (90th percentile) and low (10th percentile) storages can be directly attributed to the differences in how Lake Mead would be managed under the two alternatives. Because the traces used to simulate the 50th percentile scenarios differ between the two alternatives, the differences in simulated results are due to the combination of differences in management, hydrology, and meteorology. To project the Salton Sea's salinity, the SSAM for future inflow scenarios operates by water and salt mass conservation of the Salton Sea. At each annual time step, certain quantities are added or subtracted from the volume present at the beginning of the year. At each annual time step, the following quantities of water volume are added (+) or subtracted (-) from the volume present at the beginning of the year:

- (+) Freshwater inflows, a time series input from the relevant estimated hydrologic scenario, as discussed above.
- (-) Total water volume needed to satisfy evaporation demands of fixed-size conservation projects, when applicable.
- (-) Total water volume needed to meet dust suppression obligations, defined as 1 acre-foot of water annually per acre of area within the 2003 shoreline not covered by the remaining Salton Sea or any planned conservation projects in a given year.
- (-) Direct evaporation volume from the dynamically sized Salton Sea, dependent on its area and salinity in a given year, using the same quadratic polynomial regression in the USGS's original SSAM model (see below), which takes a baseline evaporation rate (calibrated to be 69.9 inches annually [see below]) and returns a smaller evaporation rate with increasing salinity.
- (+) Direct precipitation volume on the Salton Sea. Values from 2004–2012 are from PRISM. More recent years (2013–2022) are filled in from California Irrigation Management

Information System (CIMIS) Imperial Valley data. The historical average of the updated data set is approximately equal to 2.5 inches per year, and that is the value used for all future years.

Similarly, salt mass has the following additions (+) and subtractions (-) at each time step, assuming direct evaporation and precipitation of water have a minimal effect on the salt balance:

- (+) Salt coming in with freshwater inflows, using the inflow-dependent regression present in the USGS's original SSAM model, which has higher salt concentrations with lower inflow volumes
- (-) Annual salt precipitation of 0.15 percent of the current salt mass in the Salton Sea
- (-) Any salt above saturation salinity of 280 ppt

For any state of the Salton Sea, there is a 1-1-1 relationship between its elevation, area, and capacity (volume), also known as the elevation, area, and capacity relationship or elevation, area, and capacity curve. This relationship was estimated from the latest available bathymetry data. For each model run, this elevation, area, and capacity curve is used to get the initial Salton Sea volume (as the initial conditions are specified as an elevation) and to convert its volume at each time step to a Salton Sea area and Salton Sea elevation (interpolated to the nearest tenth of a foot, NAVD88). The evaporation rate from the Salton Sea's surface is reduced as salt concentration in it increases. The original Reclamation SSAM modeled this effect using a regression of the form:

$$E_{net} = E_{base}\left(\frac{a + b(\frac{S}{1000})^{2.5}}{a + b(\frac{S_{ref}}{1000})^{2.5}}\right)^2$$

In the formula:

- E_{base} is the baseline evaporation amount for freshwater.
- S is the Salton Sea's salinity at the current time step.
- S_{ref} is a reference salinity value (set to 45723.33 ppm).
- a and b are model constants with values of 0.981902618 and -1.39819E-07, respectively.

The salinity of the water specified as total inflow depends on the inflow volume in the form of a linear regression used in the original Reclamation model. $S_1 = a + b * V_I$, where a = 5016.07448 and $b = -0.00204508$, and this formulation has been retained in the Tetra Tech-updated version of SSAM.

The main inputs the user must provide to the model are:

- The initial Salton Sea state—these model runs were set to begin in 2020 at an elevation of 235.5 feet NAVD88 with an initial salinity of 74,250 ppm.
- Total freshwater inflow at each year, specified as a time series from the chosen starting year to 2100. This is the input that was modified to consider different drought mitigation

scenarios. The description is below of how different potential Colorado River allocations correspond to different total Salton Sea inflows.

- The baseline evaporation for each year—this was derived as a calibrated average value from historical data from 2004 to 2020. The current value has been set at 69.9 inches per year.

Although the model can simulate water use from conservation projects, the results shown in this section do not include the effects of 10-Year Plan projects, including the Species Conservation Habitat project.

DO

To project DO within Lake Powell and its water releases from Glen Canyon Dam, a long-term record of DO profiles from the reservoir forebay (site name LPCR0024; Deemer et al. 2023) were used to model and project DO concentration within a 10-meter (32.8-foot) envelope of the penstock depth for the 180 hydrologic traces generated as part of this effort. While the Lake Powell CE-QUAL-W2 does have a DO module (Williams 2007), recent observations suggested the need for its recalibration to improve performance under low water levels and with the aging of the reservoir.

A total of 132 water quality profiles from August to October (1967–2022) were used to calculate the yearly mean late summer/early fall DO concentrations in six 10-meter (32.8-foot) layers of the Lake Powell water column (Deemer 2023). These represent the heights from which water could be drawn through the penstocks under the various hydrologic traces being examined here (6 to less than 16 meters, 16 to less than 26 meters, 26 to less than 36 meters, 36 to less than 46 meters, 46 to less than 56 meters, and 56 to less than 66 meters). From these traces, linear models were built to project these water layer-specific DO concentrations as a function of minimum reservoir elevation in that year; volumes of the spring inflow, which were calculated as the inflow from April to July; and the years since the reservoir was filled.

Sediment

Net deposition of sediment in sandbars in the reach from Lake Powell to Lake Mead occurs when there is enough sand for sandbar building and when HFEs are conducted. The USGS (Salter and Grams 2023) used the Mueller et al. (2021) Sandbar Model and the Wright et al. (2010) Sand Routing Model to project sandbar building and HFE implementation triggers.

Under the Sand Routing Model, the USGS ran each hydrologic trace with 22 possible Paria River sediment loads (the Paria River is a significant sediment source and tributary to the Colorado River); each trace was associated with a 5-year period. The Sandbar Model was run with a subset of four Paria traces (1993–2003, 2006–2010, 2011–2016, and 2017–2022), representing a broad range of potential cumulative Paria sand load values. Observation data up until August 10, 2023, for the Paria sediment load time series from RM 30, RM 61, and RM 87 were used as inputs for the Sand Routing Model. The discharge records for RM 30 and RM 61 ended in late May and early June 2023. Missing observation data were calculated using the Wiele and Griffin (1997) Flow Routing Model. For future projections, predicted hourly flow releases from the WAPA Generation and Transmission Maximization Model (GTMax) and the Paria sediment load traces were used as inputs.

The Sandbar Model was calibrated to nine of the most dynamic sandbars out of the 45 sandbars that are monitored long term. The calibration period was 2015–2022. Historical and current (observation) data for sediment and flows from the RM 30 gage were used as inputs for the Sandbar Model. Sediment and flow data obtained from the Sand Routing Model at RM 30 were used to calculate the Sandbar Model future projections.

Assumptions

Salinity and Temperature

Under the CE-QUAL-W2 model, the testing of the "new" Lake Powell water quality model was carried out over a historical simulation period. This relatively long duration allowed for the evaluation of the influence modeling assumptions, such as the use of constant bathymetry and the omission of ephemeral tributary sources, which is important when modeling future climate change and/or hydrologic conditions. For this simulation, a combination of measured and modeled input data were used following the methods described by Mihalevich (2022). Reclamation provided hourly release data from Glen Canyon Dam penstocks and bypass outlets. Sub-hourly water quality data measured below Glen Canyon Dam near Page, Arizona (USGS gage #09379901), were used to evaluate model projections. Under historical conditions, the model can predict release temperatures from Glen Canyon Dam with a root mean squared error of 0.79°C and specific conductivity, which is a surrogate for TDS, of release water with a root mean squared error of 36.71 µS/cm.

Performance of the Lake Mead W2 model has been thoroughly evaluated and documented elsewhere. The improved model was calibrated to observations for 2013–2019. During this period, the mean absolute error for the simulated daily outflow temperature was 0.5 °C; the mean absolute error for the simulated daily TDS was 16 mg/L (Hydros 2020). Retrospective reviews of quarterly forecasts for TDS below the Hoover Dam in 2020 and 2021 showed that the mean absolute error was less than 15 mg/L and less than 28 mg/L, respectively. These are on par with the expected range of measurement uncertainty (Hydros 2021, 2022).

Release temperatures were evaluated based on 16°C (60.8°F) and 20°C (68°F) thresholds. When temperatures exceed a 16°C (60.8°F) threshold for extended periods of time, the likelihood that smallmouth bass and other warmwater, nonnatives species increase in abundance is much higher. When temperatures exceed 20°C (68°F) for longer periods of time, the temperatures are expected to negatively impact salmonids. Smallmouth bass and other warmwater, nonnative species pose a serious risk to native fish species in the Colorado River downstream of Glen Canyon Dam, while rainbow trout are a desired species for the Blue Ribbon fishery in the tailwater segment of Glen Canyon Dam. See **Section 3.13**, Biological Resources, for more information.

DO

The DO model was based on the best model for projecting whole-metalimnion mean DO in the late summer and fall (Deemer 2023). In cases where the reservoir elevation was less than 3,490 feet, it was projected that a high end of 8 mg/L DO concentration would pass downstream. This assumption was based on the aeration observed when water is spilled through the river outlet works (Hueftle and Stevens 2001; Vernieu 2010). Bypass releases of 15,009 cfs during the 2008 HFE resulted in supersaturated DO concentrations (12.6 mg/L; Vernieu 2010) below Glen Canyon Dam; therefore, 8 mg/L DO was considered a conservative estimate for spills under lower lake elevations

with bypass spill rates of 14,620 cfs at lake elevations of 3,490 feet and spill rates dropping at lower elevations. This modeling exercise did not attempt to characterize monsoon-driven low DO events. Lake Powell can also develop low oxygen zones due to inputs from monsoon storms, as observed in 2021.

Sediment

The Sandbar and Sand Routing Models used an HFE magnitude of 40,000 cfs, with the assumption that low lake levels are likely to limit the maximum capacity (45,000 cfs) that can be released from Glen Canyon Dam. The Sandbar Model assumed a constant exponential erosion rate that is independent of discharge. It did not capture enhanced erosion rates from elevated flows. Though sand is available in the river at flows greater than the river stage (8,000 cfs), it can only be deposited on sandbars at or below the river stage. Dam operations do not allow for sustained discharges lower than 5,000 cfs at night and 8,000 cfs during the day (Reclamation and NPS 2016). Some of the hydrologic traces included discharges below these minimums; however, the model was conditioned such that HFEs would not be implemented if discharges were below the minimums. The Sandbar Model is calibrated to yield the volume of sand at and above the 8,000 cfs river stage. Some traces include elevated sustained dam releases (20,000 cfs–30,000 cfs) that are projected to produce some sandbar growth; however, given that sandbars can only be built at and below the river stage, these deposits would occur at low elevations that would not be usable for beaches (camping uses). The Sand Routing Model projects there is a relationship between sand export and HFE duration; that is, sediment loss occurs as the HFE duration increases. To find the sediment-triggered HFE duration, the Sand Routing Model results are used to generate a simplified relationship between HFE duration and sand export.

For simplicity, the analysis assumes no sediment inputs for the remainder of August 2023. Due to the large amount of sand export since July 1, 2023, and small observed inputs prior to August 10, 2023, the probability of a sediment trigger in fall 2023 is lower than for the fall of subsequent years.

Impact Indicators

For both alternatives evaluated, the following indicators were used to assess impacts:

- **Elevation protection:** Changes due to elevation protection with reservoir elevations not analyzed in the 2007 FEIS
- **Low flows:** Changes to river flows not analyzed in the 2007 FEIS
- **Upper Basin drought:** Changes due to drought in the Upper Basin not analyzed in the 2007 FEIS

Constituents Excluded from Analysis

Since the 2007 FEIS was released, perchlorate containment and reduction strategies have continued to contribute to declining detectable concentrations of perchlorate in Lake Mead, Willow Beach, Lake Havasu, and other sampling locations in the lower Colorado River, as well as in areas using Colorado River water in Arizona. From sampling completed in Lake Mead from 2013 to 2023, perchlorate concentrations ranged from indetectable levels to 5.6 parts per billion (ppb) (SNWA 2023).

Since conditions have improved and remediation efforts are ongoing, perchlorate was not brought forward for analysis.

Issue 1: How would elevation protection and low-flow conditions affect salinity within each reach?

Summary

There is no limit for the salinity concentration in waters released from Glen Canyon Dam; however, Hoover Dam has a limit of 723 mg/L, as seen in **Table 3-20**. There is a cyclical relationship between the salinity of inflows to Lake Powell and the salinity of waters below Hoover Dam; this cyclical relationship typically follows a 2-year lag. These salinity levels are a major factor driving salinity in Lake Mead (Tillman et al. 2019). The CE-QUAL-W2 two-dimensional hydrodynamic model results also illustrated a general trend between Lake Powell elevations and salinity concentrations.

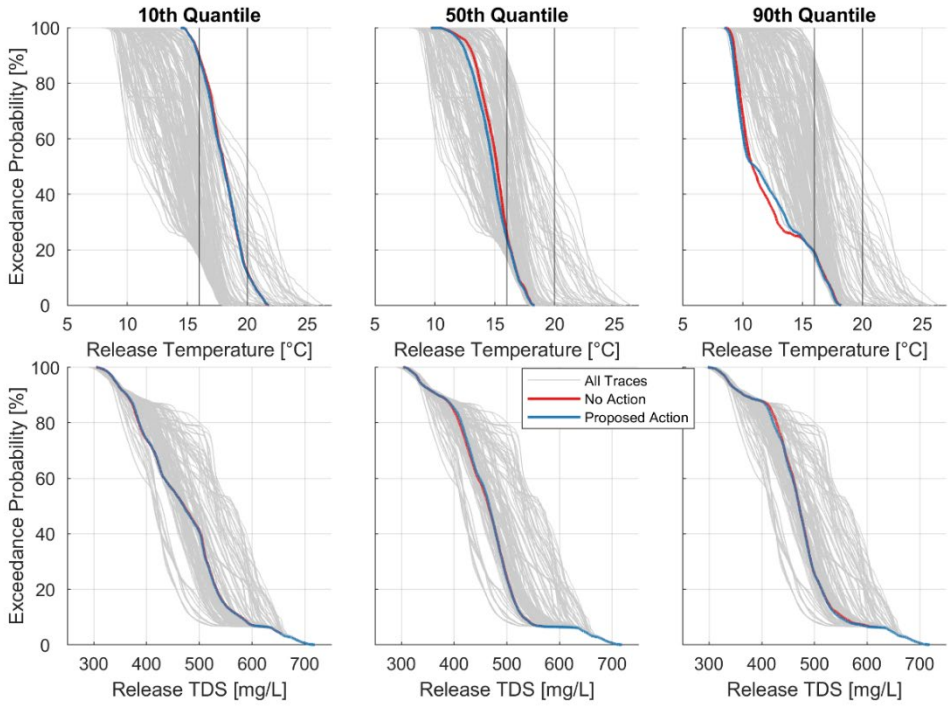
Generally, when Lake Powell's elevations were high, salinity releases were lowest; however, salinity concentrations were similar among the selected 10th, 50th, and 90th quantile reservoir elevations, as seen in **Figure 3-28**. (For a description of the traces chosen, see the Methodology section). Reservoir inflows were nearly identical among management scenarios within each trace, suggesting a strong linkage between inflow volume and release salinity. Salinity concentrations are also highly seasonal under both management scenarios due to spring inflows and seasonal turnover, which results in concentrations increasing over winter (December–March) and decreasing during the spring and summer months (May–September).

Predicted salinity from Glen Canyon Dam varied greatly between traces, but results from the No Action Alternative and Proposed Action were relatively similar.

Predicted salinity concentrations in Hoover Dam outflow vary among scenarios (**Figure 3-29**, **Figure 3-30**, and **Figure 3-31**) with variability more closely related to the hydrologic trace than management alternative. All six modeled scenarios showed a decrease in outflow salinity concentrations from the start of the simulation (June 1, 2023) through mid-2024, after which point outflow salinity concentrations tend to vary between approximately 550 and 590 mg/L (**Figure 3-29**); the exception is the No Action Alternative in the 50th percentile scenario, which continues to decrease and reaches concentrations as low as approximately 510 mg/L.

Comparing the two management alternatives under the 10th percentile and 90th percentile scenarios (**Figure 3-30**, left and right panels) shows there is little difference in simulated outflow salinity between the two management alternatives for a given hydrologic trace. The 50th percentile scenarios (**Figure 3-30**, center) show a larger difference between the two management alternatives, though this is due to differences in the underlying hydrology and meteorology used in the two model runs.

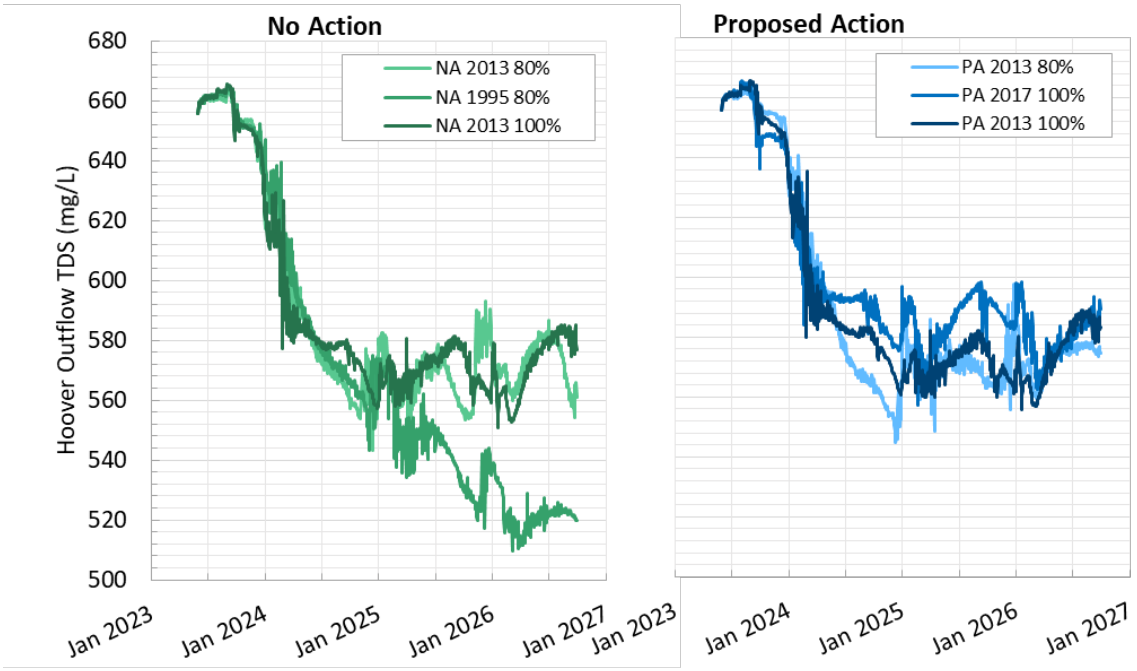
Figure 3-28
Exceedance Probability for Temperature and Salinity* Concentrations in Glen Canyon Dam Releases



Source: USGS 2023c

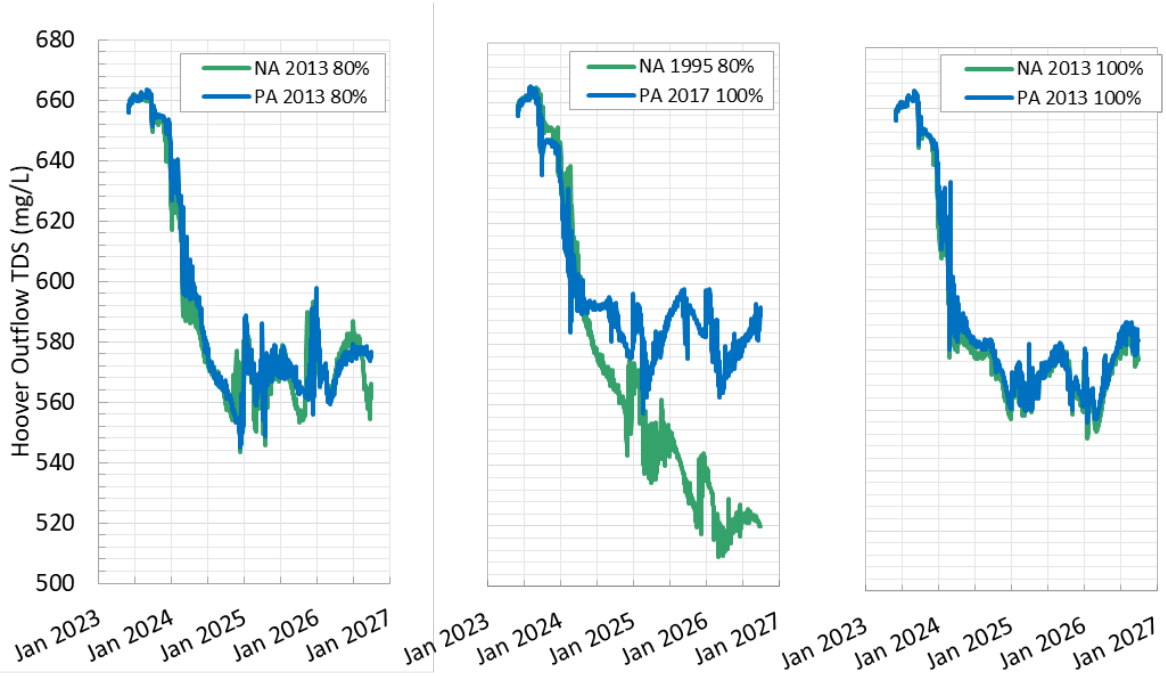
* Salinity is the measure of the amount of dissolved salt in water; TDS measures all dissolved solids in a water sample, and it is a similar constituent because it estimates the level of salt within a water sample. TDS was used in the CE-QUAL-W2 model as a proxy for salinity.

Figure 3-29
Predicted Salinity* Concentrations below Hoover Dam for Selected Traces for the No Action Alternative and Proposed Action



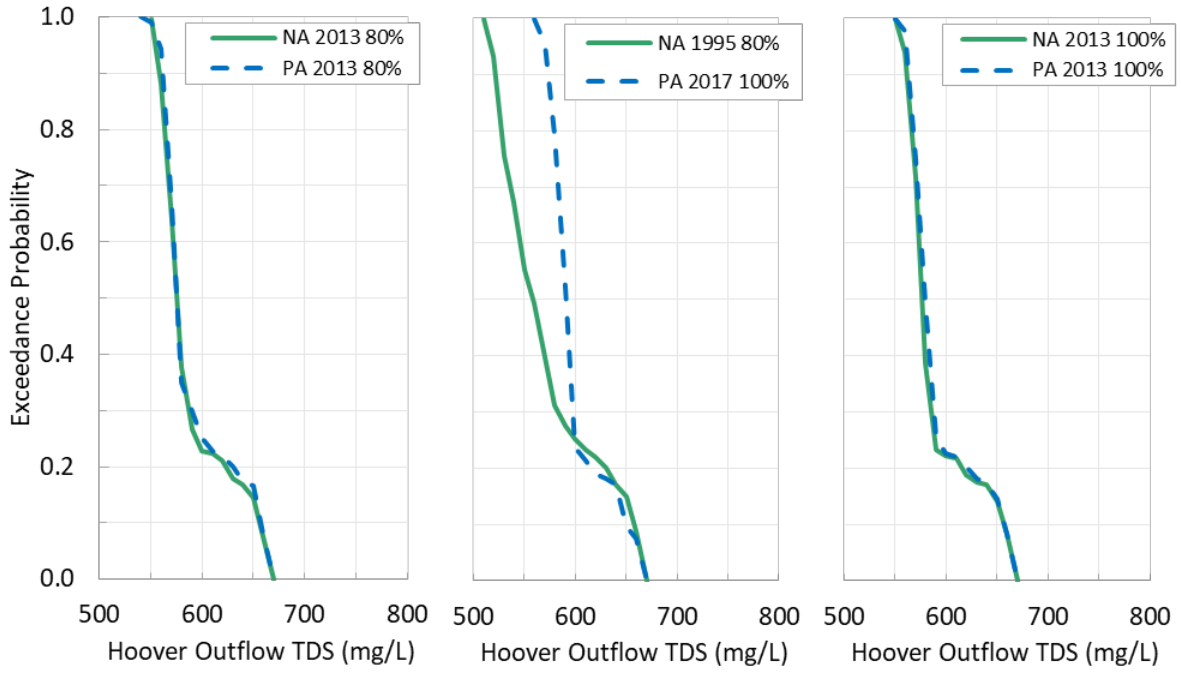
* Salinity is the measure of the amount of dissolved salt in water; TDS measures all dissolved solids in a water sample, and it is a similar constituent because it estimates the level of salt within a water sample. TDS was used in the CE-QUAL-W2 model as a proxy for salinity.

Figure 3-30
Predicted Outflow Salinity* Concentration for the No Action Alternative and Proposed Action, Grouped by Selected Trace Cases



* Salinity is the measure of the amount of dissolved salt in water; TDS measures all dissolved solids in a water sample, and it is a similar constituent because it estimates the level of salt within a water sample. TDS was used in the CE-QUAL-W2 model as a proxy for salinity.

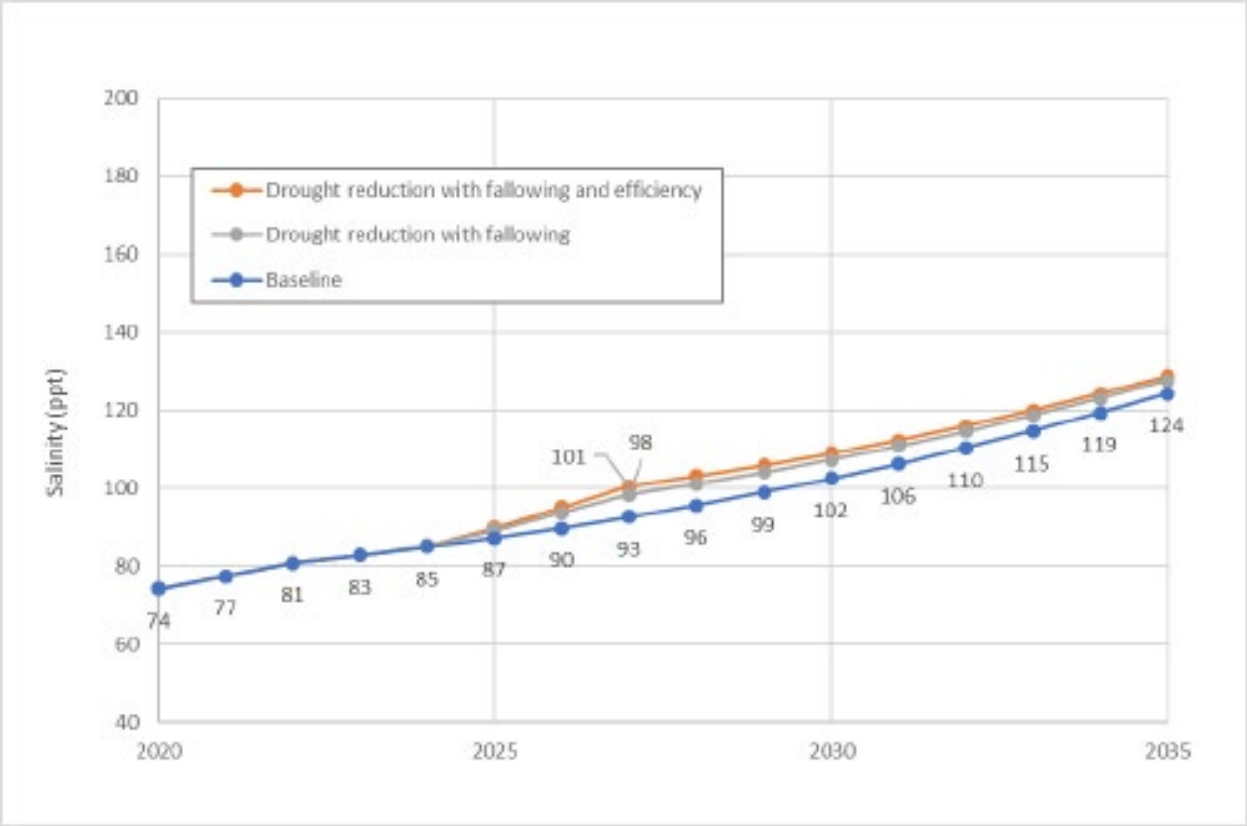
Figure 3-31
Exceedance Probability for Salinity* Concentrations in Hoover Dam Releases for Each Management Scenario, Grouped by Selected Trace Cases



* Salinity is the measure of the amount of dissolved salt in water; TDS measures all dissolved solids in a water sample, and it is a similar constituent because it estimates the level of salt within a water sample. TDS was used in the CE-QUAL-W2 model as a proxy for salinity.

Under the Proposed Action, the SEIS conservation measures could result in reduced deliveries to the Lower Division States, compared with under the No Action Alternative. As discussed in **Section 3.7**, Water Deliveries, reduced deliveries to the IID and CVWD could thus reduce inflows to the Salton Sea from irrigation drainage, expedite lakebed exposure, and therefore increase salinity of the Salton Sea. As seen in **Figure 3-32**, the SSAM estimates that salinity could be higher under the Proposed Action versus the No Action Alternative. It is inferred that the increase in salinity is due to system conservation agreements and the reduction of deliveries to the Lower Division States.

Figure 3-32
Impact on Salton Sea Salinity from Drought-Reduction Scenarios



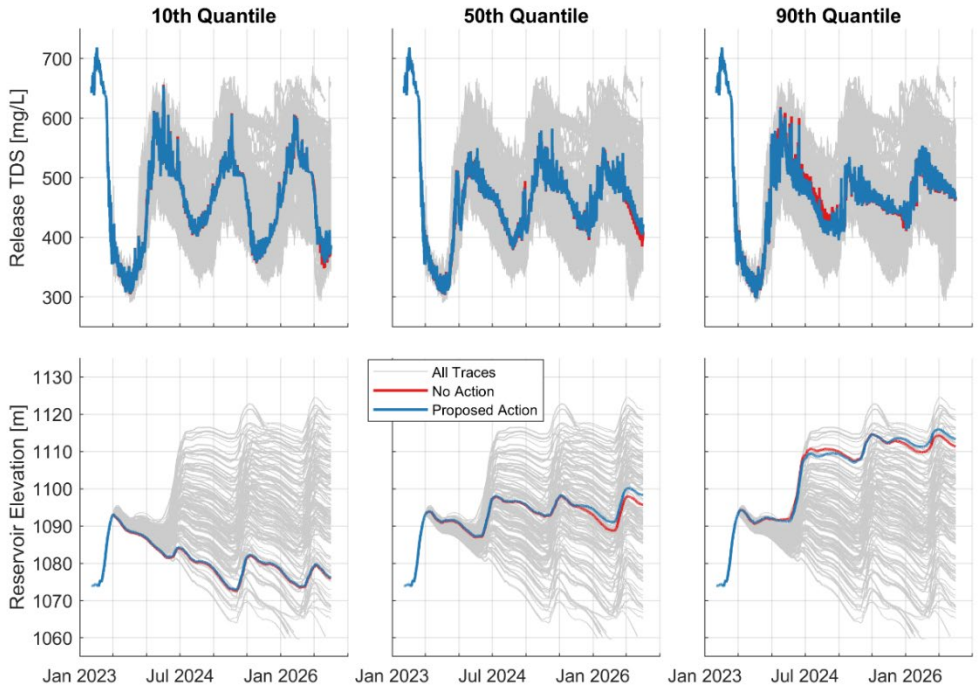
Source: Tetra Tech 2023

No Action Alternative

Under the No Action Alternative, salinity concentrations in waters released from Glen Canyon Dam and Hoover Dam would not exceed 723 mg/L, which is the numeric salinity criteria for Hoover Dam, as seen in **Figure 3-28** and **Figure 3-31**. While Glen Canyon Dam releases are related to the salinity concentrations at Lake Mead and in the waters below Hoover Dam, these modeling results do not represent Hoover Dam release concentrations.

Figure 3-33 further illustrates the trend between Lake Powell elevations and salinity concentrations, with higher lake levels resulting in marginally lower concentrations and lower levels resulting in marginally higher concentrations.

Figure 3-33
Projected Release Salinity* Concentration (mg/L) from Glen Canyon Dam over the 5-Year Simulation Period



Source: USGS 2023c
*Salinity is the measure of the amount of dissolved salt in water; TDS measures all dissolved solids in a water sample, and it is a similar constituent because it estimates the level of salt within a water sample. TDS was used in the CE-QUAL-W2 model as a proxy for salinity.

Proposed Action

Under the Proposed Action, salinity concentrations in waters released from Glen Canyon Dam and Hoover Dam would not exceed 723 mg/L, which would be the same as under the No Action Alternative, as seen in **Figure 3-28** and **Figure 3-31**.

Figure 3-33 further illustrates the trend between Lake Powell elevations and salinity concentrations, with higher lake levels resulting in marginally lower concentrations and lower levels resulting in marginally higher concentrations.

As seen in **Figure 3-32**, there would be some effects on the Salton Sea's salinity from the implementation of drought-reduction scenarios under the Proposed Action; there would be an increase in salinity when compared with the No Action Alternative.

Cumulative Effects

The potential operational changes included in the LTEMP SEIS flow options would change how and when releases from Glen Canyon Dam take place. Several of these flow options include releasing water through the river outlet works, which are lower than the penstocks, which are where

water is typically released when hydropower is generated. The difference in salinity between the penstocks and river outlet works is typically negligible during turnover; however, the salinity concentrations at the two elevations are highly variable, and they can be as high as 300 mg/L, which can increase the concentrations of salinity releases under certain conditions.

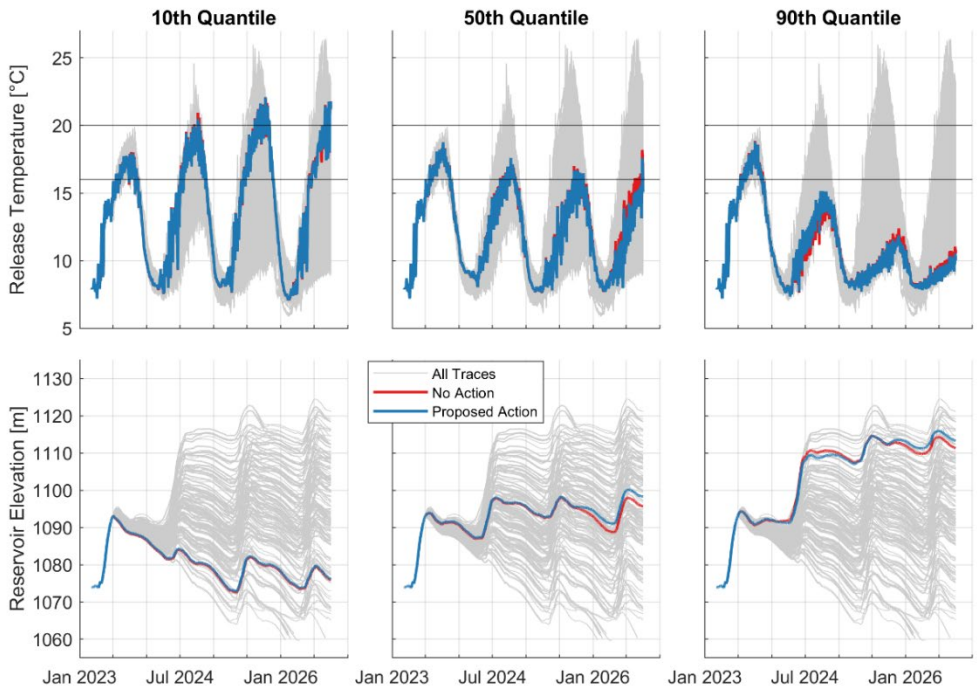
At the Salton Sea, the implementation of the activities as described in the US Army Corps of Engineers EA for the implementation of the 10-Year Plan's projects for aquatic habitat restoration would continue to improve conditions, including decreased salinity concentrations over time.

Issue 2: How would elevation protection and low-flow conditions affect the temperature within each reach?

Summary

As seen in **Figure 3-34**, projected temperature releases varied greatly among different scenarios. (For a description of the traces chosen, see the Methodology section.) A key determinant of Glen Canyon Dam release temperatures is the elevation of the reservoir relative to where water is being released, either from the penstocks, which are at 3,490 feet, or from the river outlet works, which are at 3,370 feet.

Figure 3-34
Projected Release Temperatures from Glen Canyon Dam over the 5-Year Simulation Period for Each Selected Trace and Management Scenario*



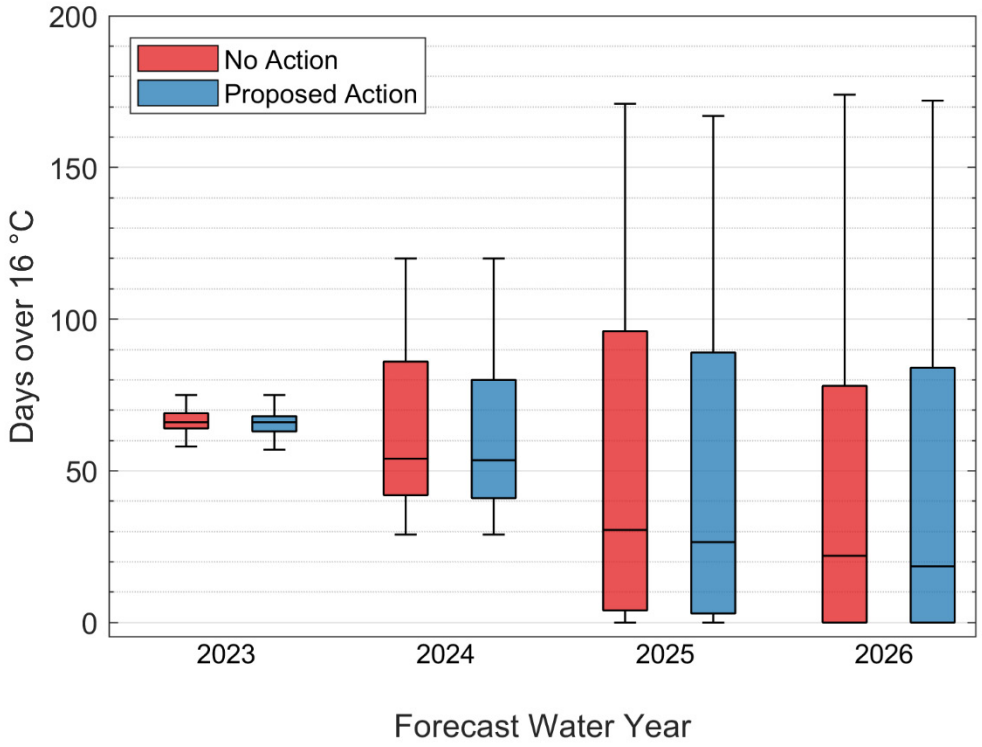
Source: USGS 2023c

*Hourly projections from the model were averaged to daily values for illustrative purposes. The horizontal, black lines represent the 16°C (60.8°F) and 20°C (68°F) temperature thresholds.

As seen in the CE-QUAL-W2 model results for Glen Canyon Dam releases in **Figure 3-34**, while the projected temperature releases varied widely, outcomes were relatively similar between the No Action Alternative and the Proposed Action. Under both alternatives, release temperatures were coldest when reservoir elevations were highest.

As seen in **Figure 3-35**, the temperature of Lake Powell releases was evaluated based on important temperature thresholds for smallmouth bass and rainbow trout. Smallmouth bass are a concern because the Service's 2018 species status assessment listed this invasive predator as one of the biggest threats to the federally listed humpback chub in the Grand Canyon. When temperatures exceed 16°C (60.8°F), the likelihood that smallmouth bass and other warmwater, nonnative species increase in abundance is much higher. When temperatures exceed 20°C (68°F) for longer periods of time, these higher temperatures are expected to negatively impact salmonids. Smallmouth bass and other warmwater, nonnatives pose a serious risk to native fish species in the Colorado River downstream of Glen Canyon Dam. See **Section 3.13**, Biological Resources, for more information.

Figure 3-35
Box Plots Showing the Number of Days with an Average Glen Canyon Dam Release Temperature over 16°C (60.8°F) for All CRMMS Traces and Each Alternative for Operating Years 2023–2026*



Source: USGS 2023c
* The dark line represents the median, the boxes represent the upper and lower 25 percent quantiles, and the whiskers extend to twice the interquartile range with dots representing traces with more extreme values.

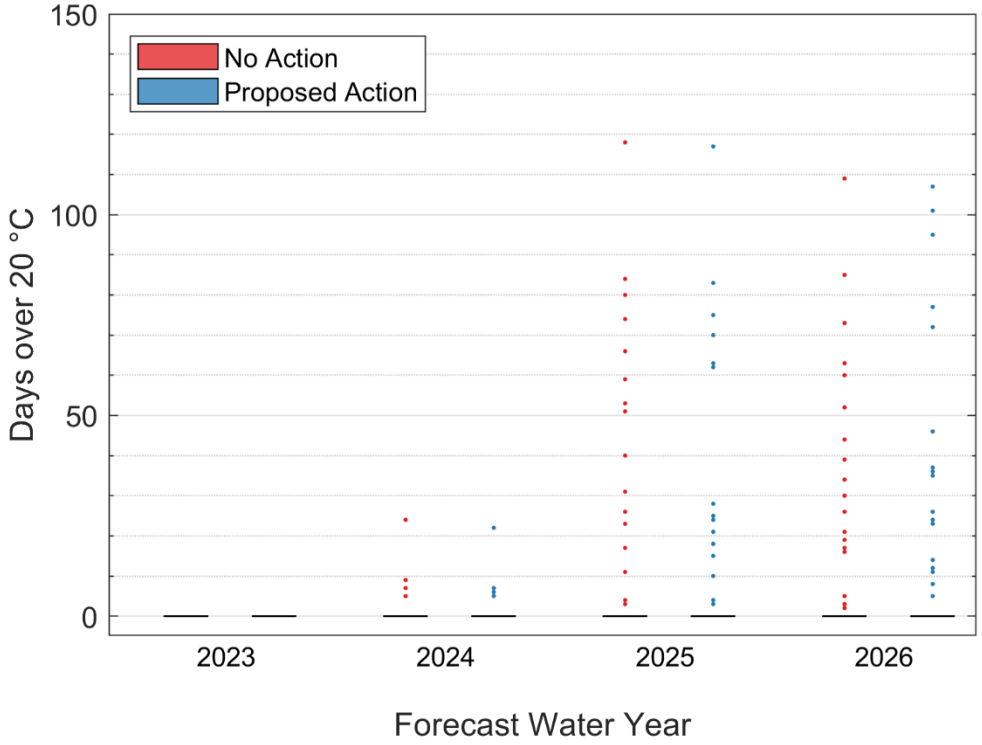
In the traces modeled, release temperature predictions associated with the 10th quantile of reservoir elevations, which would be the lowest reservoir elevations, were greater than 16°C (60.8°F) over all summer months (June–August) and greater than 20°C (68°F) during 2024, 2025, and 2026 summer periods. Predicted release temperatures corresponding to the 50th quantile of reservoir elevations were never greater than 20°C (68°F), and they exceeded 16°C (60.8°F) for a shorter duration compared with lower reservoir elevations (that is, the 10th quantile). Under the 90th quantile of reservoir elevations, which would be the high reservoir elevations, predicted release temperatures only exceeded 16°C (60.8°F) in the summer of 2023 and were below the 16°C (60.8°F) threshold in subsequent years of the simulation.

Across the traces simulated in the CE-QUAL-W2 Lake Powell water quality model, the Proposed Action led to slightly more days above 16°C (60.8°F), on average, in operational years 2024 and 2025 but slightly fewer days above 16°C (60.8°F) in operational year 2026, when compared with the No Action Alternative. Both the No Action Alternative and the Proposed Action had traces that exceed the 20°C (68°F) threshold; however, more than half of the traces simulated were below this threshold for each operational year (**Figure 3-36**). In operational year 2023, no traces exceeded the 20°C threshold. Under both alternatives, 5 and 18 percent of all traces in operational year 2024 and 2025, respectively, exceeded the 20°C threshold. In operational year 2026, 22 percent of traces exceeded the 20°C threshold under the No Action Alternative, and 25 percent of traces exceeded the 20°C threshold under the Proposed Action. Release temperatures are strongly tied to where water would be released from, which impacted the probability of whether releases from the river outlet works would be necessary under the No Action Alternative.

For Hoover Dam, predicted outflow temperatures vary among scenarios (**Figure 3-37**), with variability more closely related to the hydrologic trace than the management alternative. For all scenarios, outflow temperatures are similar among hydrologic traces (less than 3°C variability) when the reservoir is well mixed (fall through spring). However, during the stratified period, forecasted outflow temperatures are more variable (up to approximately 5°C) among traces for a given alternative. These differences are largely explained by the water elevation.

Simulated water surface elevation for each scenario is shown in **Figure 3-38**, with Hoover Dam outlet elevations demarcated. Because surface waters in the reservoir are warmer, as the water elevation decreases and moves closer to the outlet elevation, summer outflow temperatures increase. When water elevations are higher, water is withdrawn from deeper in the water column, and is often colder. For both scenarios using 2013 100 percent ESP (90th percentile of projected storage), outflow of surface water through the upper gate would occur for the entire simulation period (**Figure 3-38**); however, outflow of cold, deep water through the lower gate would moderate temperature variability below Hoover Dam (**Figure 3-37**). The warmest outflow temperatures under either alternative occur during late summer and fall when low storage in the reservoir only allows for water to be withdrawn from the lower outlet gates.

Figure 3-36
Box Plots Showing the Number of Days with an Average Glen Canyon Dam Release Temperature over 20°C (68°F) for All CRMMS Traces and Each Alternative for Operating Years 2023–2026*



Source: USGS 2023c
* The dark line represents the median, the boxes represent the upper and lower 25 percent quantiles, and the whiskers extended to twice the interquartile range with dots representing traces with more extreme values.

Figure 3-37
Predicted Temperature of Hoover Dam Outflow for Selected Traces for the No Action Alternative and Proposed Action

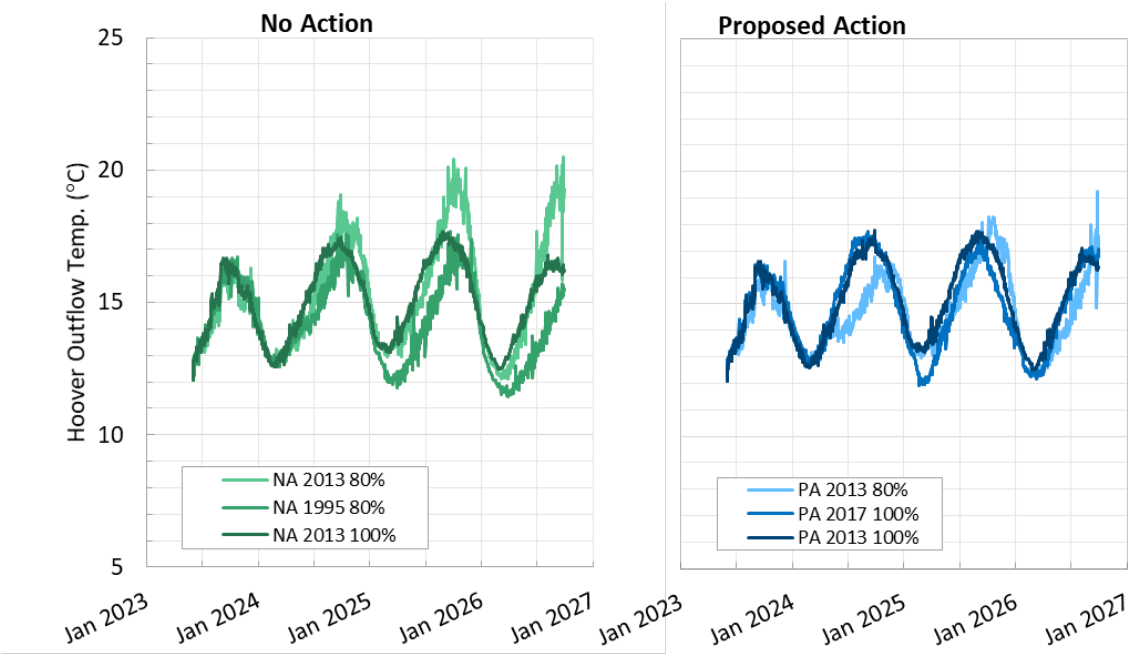
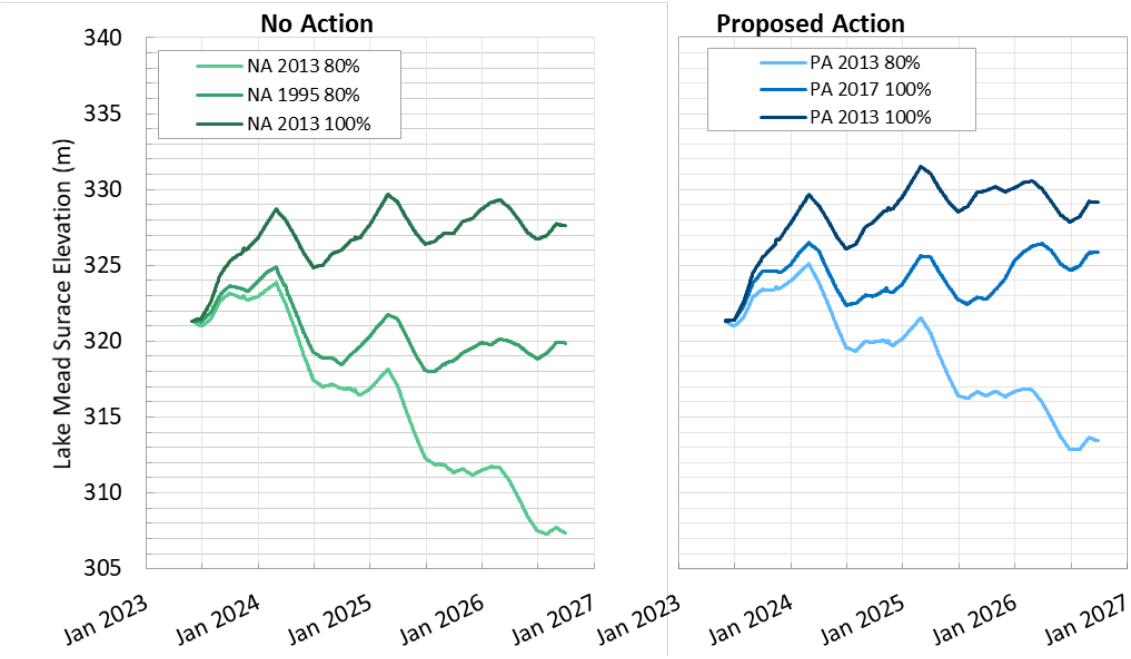


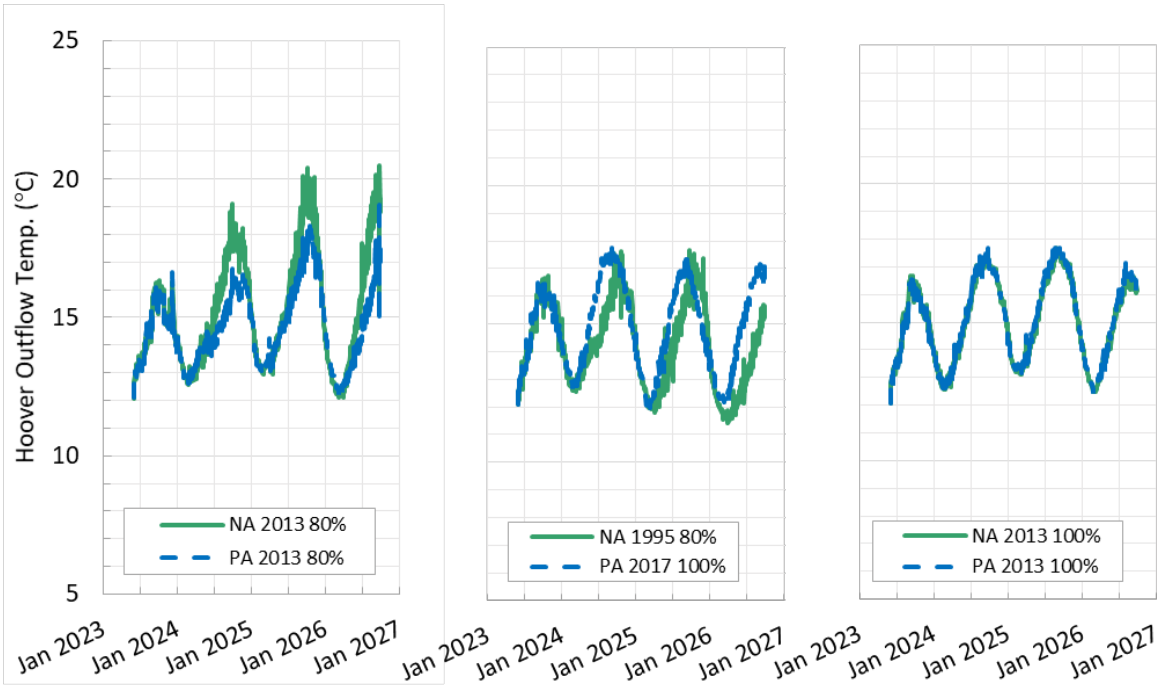
Figure 3-38
Simulated Lake Mead Water Surface Elevation for Selected Traces for the No Action Alternative and Proposed Action



Comparisons between the No Action Alternative and the Proposed Action are shown in **Figure 3-39**. For Hoover Dam, direct comparisons can be made for the two management alternatives at the 10th and 90th percentiles, as they both use the same hydrologic traces (2013 80 percent ESP and 2013 100 percent ESP). Simulated water temperatures in Hoover Dam outflows are nearly identical when the reservoir is relatively full (under the 90th percentile scenario). In the 10th percentile scenario, simulated outflow temperatures are notably higher during summer under the No Action Alternative, reflecting the lower storage under the No Action Alternative when compared with the Proposed Action (**Figure 3-39**).

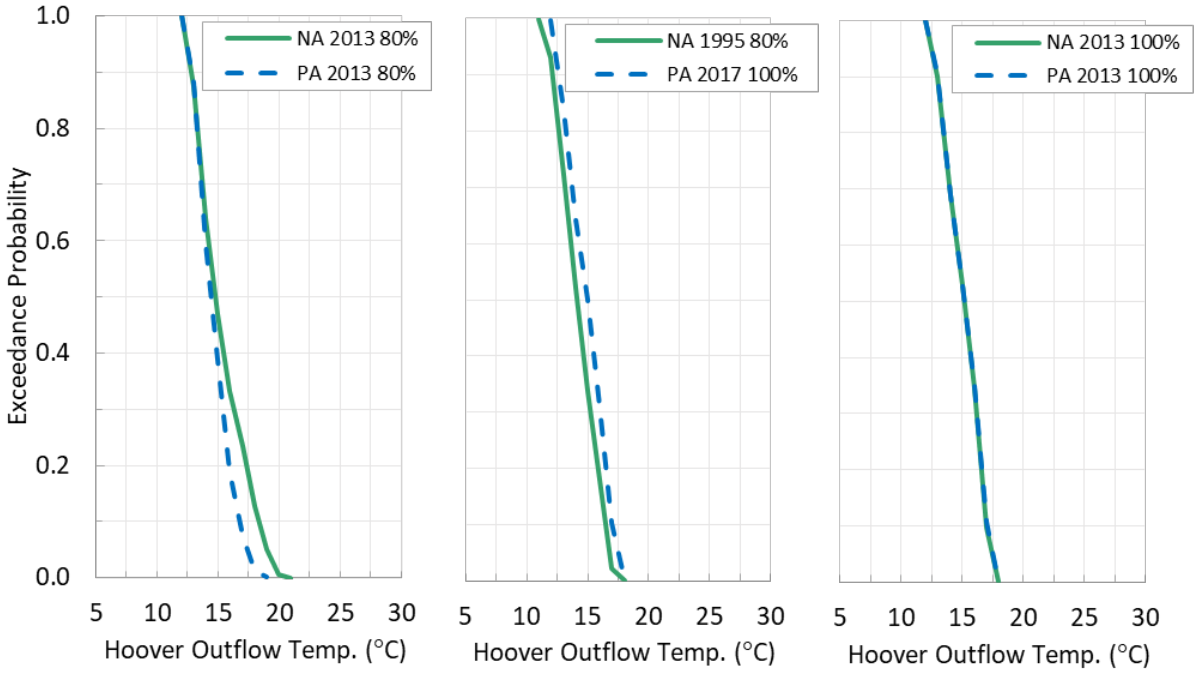
In the 50th percentile scenario, outflow temperatures tend to be higher under the Proposed Action than under the No Action Alternative, despite higher surface elevations under the Proposed Action. This result is attributed to a combination of differences in the hydrologic traces used in the 50th percentile scenario (1995 80 percent ESP for the No Action Alternative and the 2017 100 percent ESP for the Proposed Action) and the corresponding differences in meteorology used to simulate those traces (1995–1998 for the No Action Alternative and 2017–2020 for the Proposed Action). These differences in hydrology and meteorology limit the utility of the comparison of alternatives under the 50th percentile scenarios; however, based on results from the 10th and 90th percentile scenarios, it would be expected that outflow temperatures under the Proposed Action would likely be similar or cooler than outflow temperatures under the No Action Alternative.

Figure 3-39
Predicted Outflow Temperatures for Each Management Scenario, Grouped by Selected Trace Cases



Exceedance probability plots for daily outflow temperature are shown in **Figure 3-40**. The greatest variability between alternatives occurs under the 10th and 50th percentile scenarios (left and center panels, respectively). As previously mentioned, this is due to differences in projected storage elevations in the 10th percentile scenario, and differences in the simulated hydrologic trace and meteorology for the 50th percentile scenario.

Figure 3-40
Exceedance Probability for Temperature in Hoover Dam Releases for Each Management Scenario, Grouped by Selected Trace Cases



No Action Alternative

As seen in the CE-QUAL-W2 model results for Glen Canyon Dam and Hoover Dam releases in **Figure 3-34** and **Figure 3-37**, predicted release temperatures varied widely among the projected traces; the coldest release temperatures occurred when reservoir elevations were the highest.

In the traces examined using the CE-QUAL-W2 model for the No Action Alternative, release temperatures were strongly linked to the elevation of Lake Powell relative to where the water is being released, which affects the probability of exceeding specific temperature thresholds. Below Glen Canyon Dam, the No Action Alternative had traces that exceeded the 20°C (68°F) threshold; however, more than half of the traces simulated were below this threshold for each operational year (**Figure 3-36**).

Proposed Action

Like the No Action Alternative, under the Proposed Action, predicted release temperatures for both Glen Canyon Dam and Hoover Dam varied widely among the project traces; however, the

outcomes were relatively similar to those under the No Action Alternative. The coldest release temperatures occurred when reservoir elevations were the highest.

Compared with the No Action Alternative, in the traces examined using the CE-QUAL-W2 model below Glen Canyon Dam, the Proposed Action would lead to slightly fewer days above the 16°C (60.8°F) threshold, on average, in operational years 2024 and 2025; however, the Proposed Action would exceed the 16°C (60.8°F) threshold on slightly more days in operational year 2026, compared with the No Action Alternative. Like the No Action Alternative, the Proposed Action had traces that exceeded the 20°C (68°F) threshold; however, more than half of the traces simulated were below this threshold for each operational year (**Figure 3-36**).

Cumulative Effects

The potential operational changes included in the LTEMP SEIS flow options would change how and when releases from Glen Canyon Dam would take place. Several of these flow options include releasing water through the river outlet works, which are lower than the penstocks, which are where water is typically released when hydropower is generated. Reclamation would redirect certain release volumes from the higher hydropower-generating penstocks to the lower river outlet works. Releases from the lower river outlet works would be cooler in temperature; therefore, no additive cumulative effect would occur from Glen Canyon Dam flow options.

The implementation of the activities as described in the US Army Corps of Engineers' EA for the implementation of the 10-Year Plan's projects for aquatic habitat restoration would continue to improve conditions.

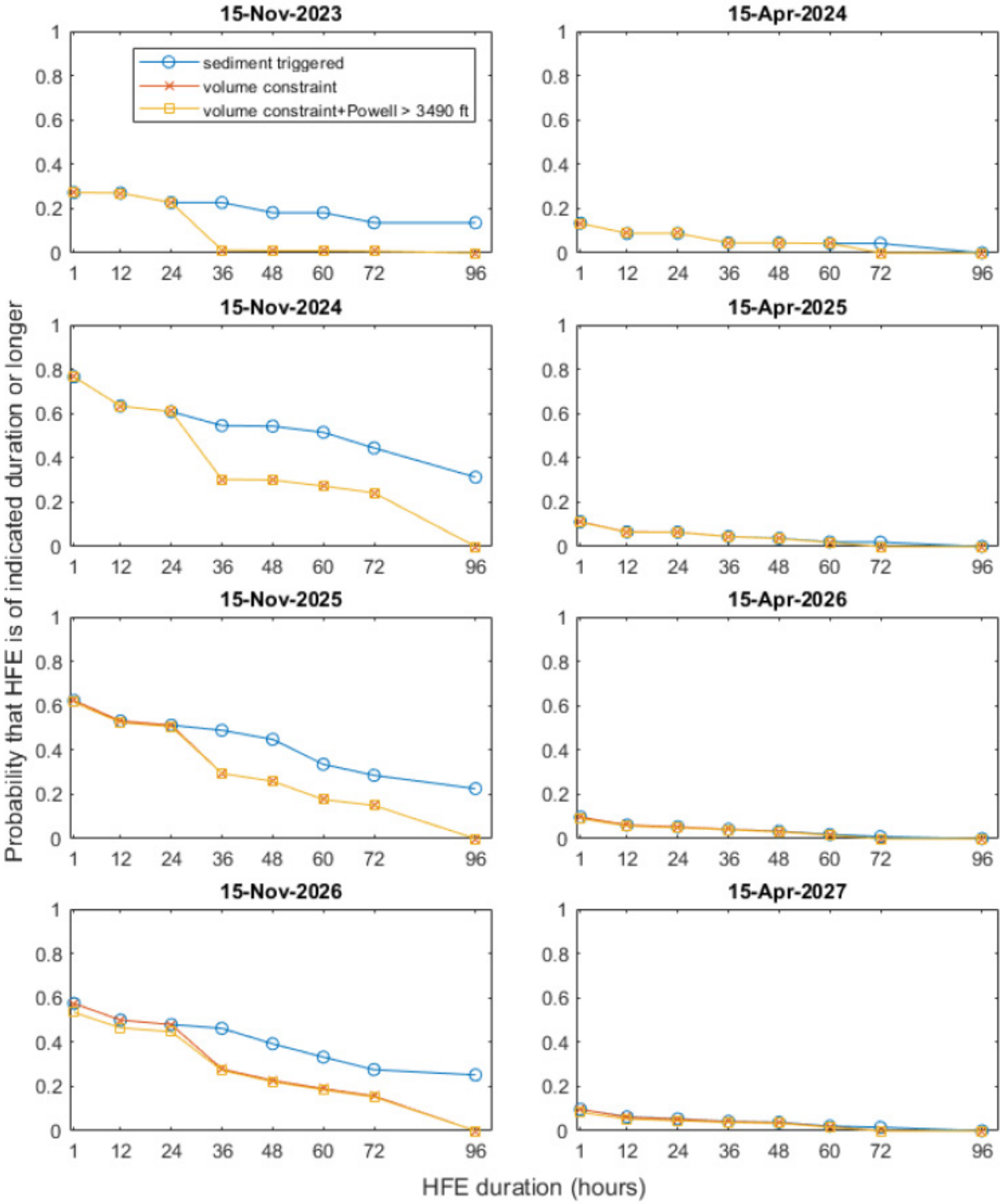
Issue 3: How would elevation protection and low-flow conditions affect the sediment within each reach?

Summary

Under both alternatives, HFEs in the reach between Lake Powell and Lake Mead (in the Marble and Grand Canyons) would not be implemented when Lake Powell elevations are below the protection level, which is 3,500 feet. Under both alternatives, and given the current LTEMP protocols, the modeling results indicate that April HFEs would be triggered for approximately 15 percent of the time, each year, between 2023 and 2026. November HFEs would be triggered approximately 25 percent of the time in November 2023 and between 60 and 80 percent of the time, each year, between 2024 and 2026 (see **Figure 3-41** and **Figure 3-42**). Between November 2024 and 2025 the probabilities for 36- and 72-hour HFE durations would decrease by approximately 5 percent under the Proposed Action, compared with the No Action Alternative. In November 2026, the Proposed Action would reduce the potential of elevations below 3,500 feet, and, therefore, would increase the probability of HFE implementation compared with the No Action Alternative.

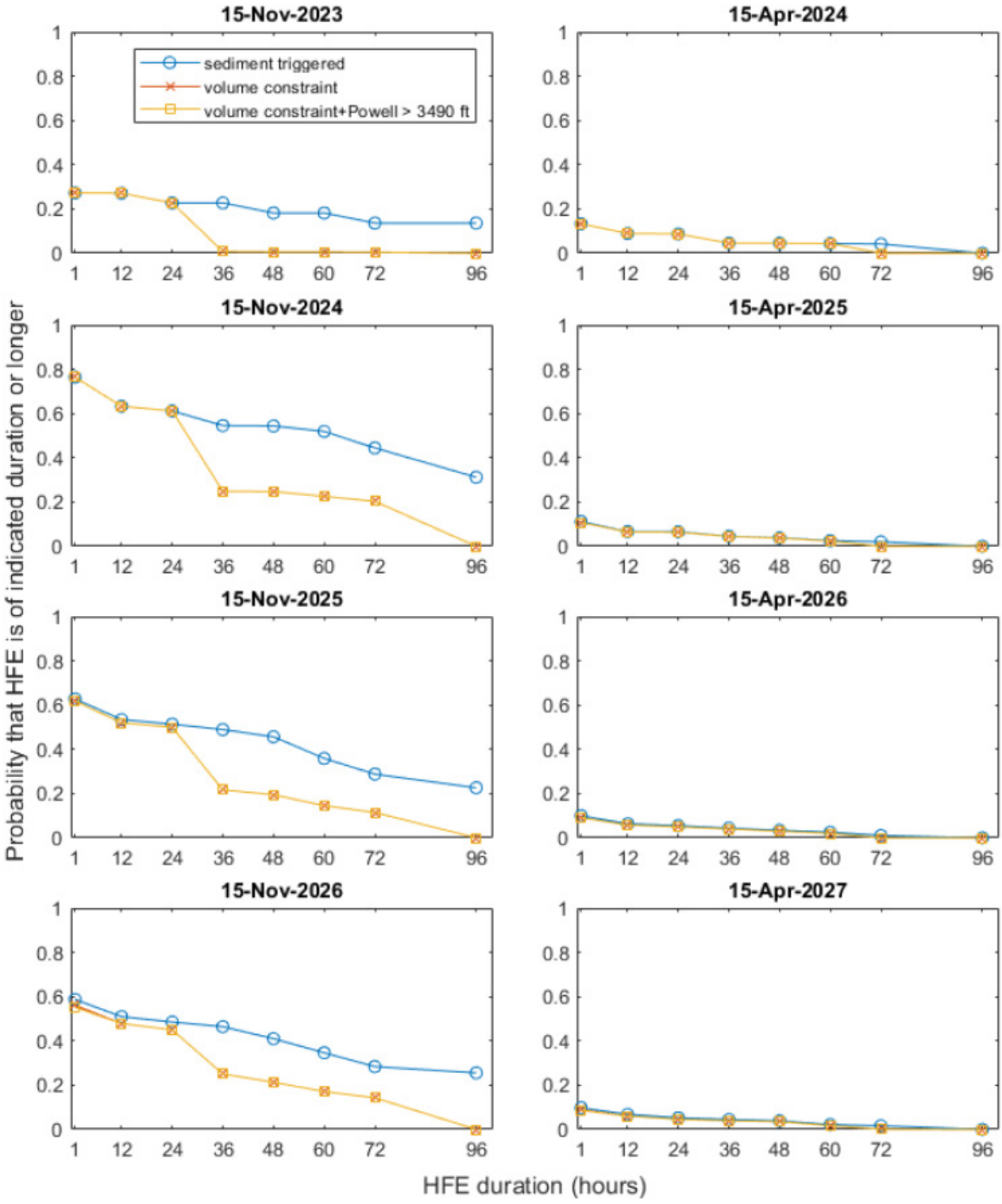
Net erosion of sandbars would occur, and sandbar building would decrease, if HFEs cannot be implemented. Due to the current net sediment export conditions and potential for future HFEs, the predicted mean annual sandbar volume is modeled to increase between 2023 and 2026 (see **Figure 3-43** and **Figure 3-44**).

Figure 3-41
Probabilities of HFE Triggers under the No Action Alternative



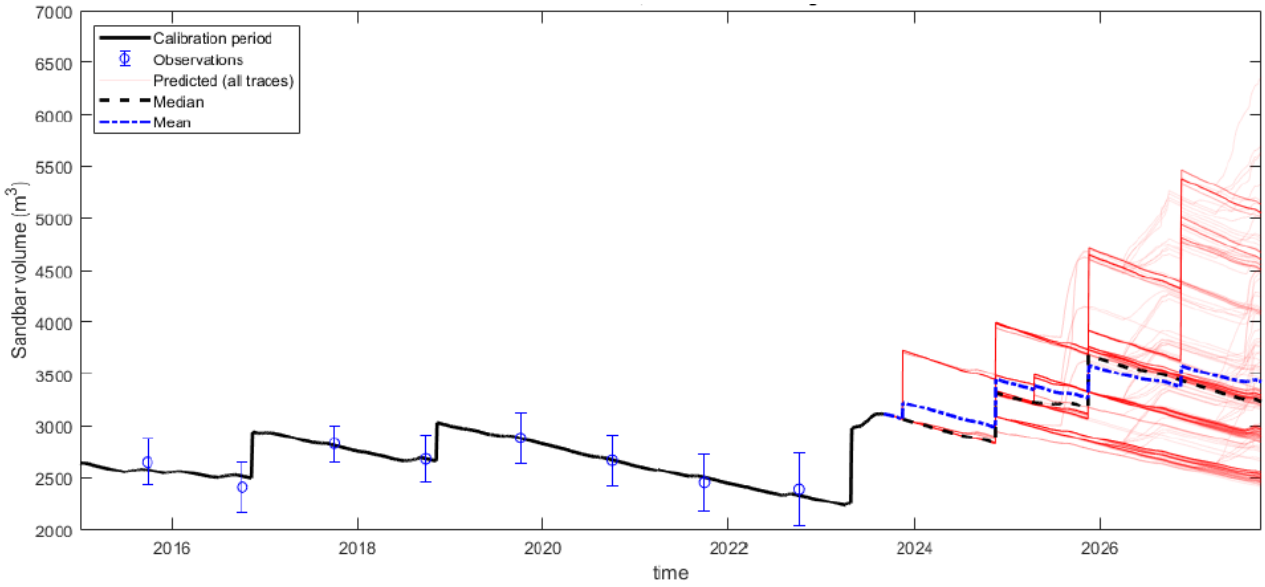
Source: Salter and Grams 2023

Figure 3-42
Probabilities of HFE Triggers under the Proposed Action



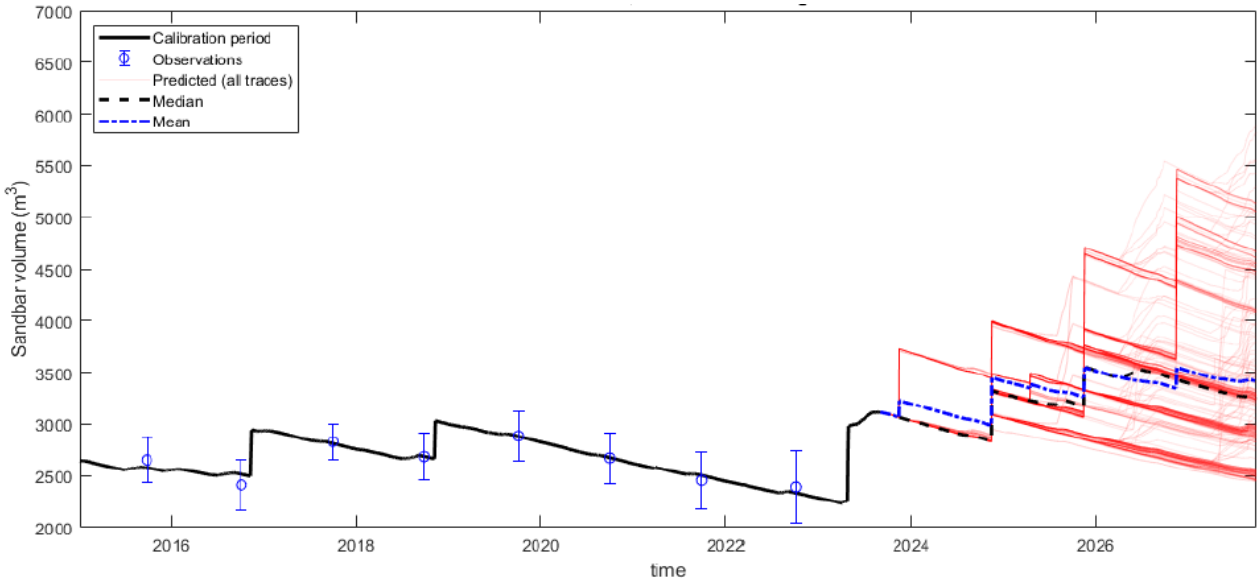
Source: Salter and Grams 2023

Figure 3-43
Observed and Predicated Sandbar Volume under the No Action Alternative



Source: Salter and Grams 2023

Figure 3-44
Observed and Predicated Sandbar Volume under the Proposed Action



Source: Salter and Grams 2023

In **Figure 3-41** and **Figure 3-42**, the "sediment-triggered" lines (differentiated with a circle at data points) represent the probability that there is enough sediment to implement an HFE of the indicated duration without causing the sand mass balance to become negative by the end of the sediment implementation window. The "volume constraint" lines (differentiated with an x at data points) represent the probability of implementing an HFE of the indicated duration (with the volume of water allocated in the implementation month) while also maintaining LTEMP-required minimum daily LTEMP releases (see **Table 3-22**). The lines differentiated with a square at data points represent the probability an HFE of the indicated duration could be implemented, given the volume constraint combined with a constraint of a Lake Powell elevation greater than 3,500 feet (the USGS model uses a more conservative constraint of 3,490 feet). Under the last scenario, even when sufficient monthly volume is available, Lake Powell's elevation could prevent HFE implementation. Similarly, both volume constraint scenarios prevent the implementation of HFEs of the duration that are triggered following the LTEMP protocol (a 96-hour HFE).

Table 3-22
Monthly Minimum Volume Constraints for HFEs

HFE Duration	0-hour	1-hour	12-hour	24-hour	36-hour	48-hour	60-hour	72-hour	96-hour
Volume (af)[1]	394,210	426,800	456,200	490,090	522,400	556,300	588,600	622,500	688,700

Source: Salter and Grams 2023

[1]Total releases less than these volumes are not possible without decreasing flows below the LTEMP-required minimum daily (8,000 cfs) and nightly (5,000 cfs) releases.

At a 0-hour duration, an HFE would not occur. The volume constraint combined with the 3,500-feet constraint would cause HFEs of longer duration (36 to 96 hours) to be substituted with 1- to 24-hour HFEs (see **Figure 3-41** and **Figure 3-42**) during the November implementation window. The probabilities for every possible HFE duration during the April implementation window are low compared with the November implementation window. The 1-hour HFEs have the highest probability of occurrence. Based on the Mueller and Grams (2021) Sandbar Model, a 1-hour HFE is projected to be less than 5 percent as effective as a 96-hour HFE; however, those HFEs with durations shorter than approximately 60 hours have never been tested, and they would be of unknown effectiveness. Short-duration HFEs were included as an option in LTEMP to be implemented when there was insufficient sediment available for longer duration HFEs (Reclamation and NPS 2016).

Sediment dredging projects in the reach below Hoover Dam that ensure water delivery to downstream users would continue under both alternatives.

No Action Alternative

Under the No Action Alternative, low-flow conditions would continue to affect the sediment mass balance by limiting sand deposition in eddies and on sandbars in the reach between Lake Powell and Lake Mead. If Lake Powell drops below 3,500 feet, HFEs are infeasible (Salter and Grams 2023). Sand deposits in the Marble and Grand Canyons would be insufficient to build sandbars.

Under the No Action Alternative and LTEMP protocols, current modeling demonstrates that April HFEs would be triggered for approximately 15 percent of the time, each year, between 2023 and 2026. November HFEs would be triggered approximately 25 percent of the time between 2023 and 2024 and between 60 and 80 percent of the time, each year, between 2024 and 2026 (see **Figure 3-41**). These results are consistent with the modeling analyses for LTEMP, which anticipated that fall HFEs would be triggered in about 77 percent of the years and spring HFEs would be triggered in about 26 percent of the years, using different hydrologic inputs and slightly different sediment assumptions (Reclamation and NPS 2016). Given the sustained high releases in July and August 2023, as described under the affected environment, and the potential for future HFEs, the mean predicted sandbar volume would increase between 2023 and 2026 (see **Figure 3-43**).

In November 2026, there is a slight risk of dropping below the 3,500-foot elevation for 5 out of the 90 modeled hydrologic traces under the No Action Alternative. This would preclude HFE implementation.

Sediment dredging projects in the reach below Hoover Dam that ensure water delivery to downstream users would continue under the No Action Alternative.

Proposed Action

According to the modeling results, April and November HFEs under the Proposed Action would be triggered for approximately the same frequency as under the No Action Alternative (see **Figure 3-42**). However, November monthly releases are slightly lower under the Proposed Action and would result in an approximate 5 percent reduction in HFE implementation probability for 36- and 72-hour durations in November 2024 and 2025. In November 2026, the potential for the elevation to drop below 3,500 feet would decrease for more hydrologic traces under the Proposed Action (in the modeling results, only one hydrologic trace dropped below 3,500 feet; Salter and Grams 2023). This would increase the potential for HFE implementation compared with the No Action Alternative, because dropping below 3,500 feet would preclude an HFE implementation altogether. Although there are differences between the alternatives for individual traces, the mean predicted sandbar volume under the Proposed Action is similar to the volume under the No Action Alternative (see **Figure 3-44**), with only a 0.3 percent mean difference of the mean sandbar volume.

Sediment accumulation in the reach downstream of Hoover Dam would continue, as described under the No Action Alternative. The need for sediment dredging projects also would continue.

Cumulative Effects

If one of the LTEMP SEIS flow options were implemented, this would alter hourly and daily releases from Glen Canyon Dam. All but one of the likely flow options under the LTEMP SEIS include releasing water through the river outlet works, which are lower than the penstocks (the place where water is typically released when hydropower is generated). All options would include a revised annual sediment accounting period. Specific tradeoffs related to these alternatives are being addressed in greater detail in the LTEMP SEIS. Combined with the HFE implementation effects in this analysis, if the release volumes are 20,000 cfs or greater, the monthly flow constraint would increase relative to the probability of triggering an HFE. In turn, the probability of triggering an HFE would likely decrease. Between November 2024 and 2025, the No Action Alternative would

reduce this cumulative effect, compared with the Proposed Action, because the Proposed Action would have a reduced probability (an approximate 5 percent reduction) for 36- and 72-hour HFE durations during this period. In November 2026, the Proposed Action would reduce this cumulative effect, compared with the No Action Alternative, because it would reduce the potential that Lake Powell's elevation would drop below 3,500 feet. In addition, the annual sediment accounting window under the LTEMP SEIS, if approved, would reduce this cumulative effect. If an HFE is triggered and the dam releases are implemented at the duration and magnitude consistent with the LTEMP protocol, sandbar building would occur.

The implementation of the activities as described in the US Army Corps of Engineers' EA for the implementation of the 10-Year Plan's projects for aquatic habitat restoration would continue to improve conditions.

Issue 4: How would elevation protection and low-flow conditions affect DO within each reach?

Summary

Low DO events typically occur in zones of Glen Canyon Dam's metalimnion[18] in September or early October; however, they have been observed as early as August in response to large spring inflows, such as from snowmelt.

As seen in **Figure 3-45**, across both alternatives, mean August to October DO in Lake Powell is projected to drop below 5 mg/L in 79 percent of traces. The percentage of low DO events occurring in the tailwater would be slightly higher under the Proposed Action (80 percent of traces) than under the No Action Alternative (78 percent of traces). This may be due to the lower lake elevations that result from reduced hydrology, but the lake level would not be below elevation 3,490 feet, which would require releases from the river outlet works. **Figure 3-45** shows a dashed red line for 5 mg/L, which is the threshold below which oxygen concentrations are stressful to trout (see **Section 3.13**, Biological Resources, for more information), and a dashed blue line for 8 mg/L, which is the concentration modeled for bypass release. Each point represents 1 year for a total of 90 points per box whisker (30 historical reconstructions x 100 percent, 90 percent, and 80 percent).

No Action Alternative

Under the No Action Alternative, Glen Canyon Dam releases mean August–October DO levels would drop below 5 mg/L in 79 percent of traces, and tailwater low DO events were probable in 78 percent of traces. **Figure 3-45** shows the modeled mean August–October DO concentrations in Glen Canyon Dam outflows for each model year under the No Action Alternative in red.

[18] The metalimnion is the middle layer in a thermally stratified lake or reservoir.

Figure 3-45
Projections of Mean August–October DO Concentrations in Glen Canyon Dam Outflows for Each Projection Year under the Proposed Action and No Action Alternative



Source: USGS 2023b

Proposed Action

Like the No Action Alternative, under the Proposed Action, Glen Canyon Dam releases mean August–October DO levels would drop below 5 mg/L in 79 percent of traces. **Figure 3-45** shows the projections of mean August–October DO concentrations in Glen Canyon Dam releases for each projection year under the Proposed Action in blue.

Under the Proposed Action, it would be slightly likely that the tailwater below Glen Canyon Dam would have more low DO events than under the No Action Alternative. This may be due to the lower lake elevations that result from reduced hydrology but that are not low enough to trigger bypass releases.

Cumulative Effects

The potential operational changes included in the LTEMP SEIS flow options would change hourly and daily releases from Glen Canyon Dam. Several of the flow options include releasing water through the river outlet works, which are lower than the penstocks; the penstocks are where water is released when hydropower is generated. However, passage through the river outlet works would also aerate the water; therefore, this likely would not lead to a cumulative effect on DO.

The implementation of the activities as described in the US Army Corps of Engineers' EA for the implementation of the 10-Year Plan's projects for aquatic habitat restoration would continue to improve conditions.

Issue 5: How would elevation protection and low-flow conditions affect nutrients and algae within each reach?

Summary

Because the release temperature projections would be similar under the No Action Alternative and Proposed Action, both alternatives would provide opportunities for algal growth. Declining water levels in Lake Powell could promote cyanobacteria blooms, but this remains to be studied (Yang et al. 2016). These blooms could use excess available nutrients and create low DO areas.

Lower flows under the Proposed Action and decreased dilution capacity under both alternatives could result in greater concentrations of nitrogen and phosphorus; however, quantified water quality impacts related to dilution capacity are not available; therefore, it is difficult to project the quantified water quality impacts based on dilution capacity.

No Action Alternative

Under the No Action Alternative, Glen Canyon Dam releases would have similar release temperatures compared with the Proposed Action, as discussed under *Issue 2*. Therefore, there would be similar opportunities for algal growth when considering temperature.

Decreased dilution capacity could result in greater concentrations of nitrogen and phosphorus; however, quantified water quality impacts related to dilution capacity are not available; therefore, it is difficult to project the quantified water quality impacts based on dilution capacity.

Additionally, with lower reservoir levels, it is possible that phosphorus concentrations in the hypolimnion, where water would be released, could be elevated, depending on seasonality and reservoir nutrient cycling. Higher temperatures downstream and decreased concentrative power from lower water volumes could result in more opportunities for algal growth. Bypass-only scenarios would likely result in more algal growth due to steady flows versus load following flows (Deemer et al. 2022).

Under the No Action Alternative, low DO events occur in 79 percent of traces, as shown in **Figure 3-45**. This occurs in the late summer and early fall, which could lead to bioavailable phosphorus and opportunities for algal growth.

Proposed Action

Under the Proposed Action, Glen Canyon Dam releases would have similar release temperatures when compared with the No Action Alternative, as discussed under *Issue 2*. Therefore, there would be similar opportunities for algal growth when considering temperature.

Lower flows and decreased dilution capacity could result in greater concentrations of nitrogen and phosphorus; however, quantified water quality impacts related to dilution capacity are not available; therefore, it is difficult to project the quantified water quality impacts based on dilution capacity.

Additionally, phosphorus concentrations increase down the water column where releases would be made. Higher temperatures downstream and decreased concentrative power from lower water volumes could result in algal blooms and more opportunities for algal growth.

Under the Proposed Action, low DO events would occur in 79 percent of traces, as shown in **Figure 3-45**; this is the same percentage as under the No Action Alternative. The Proposed Action would have the same percentage of traces with decreased DO concentrations in the late summer and early fall when compared with the No Action Alternative, which would provide a similar amount of bioavailable phosphorus and opportunities for algal growth.

Cumulative Effects

The potential operational changes included in the LTEMP SEIS flow options would change daily and hourly releases from Glen Canyon Dam. Several of the flow options include releasing water through the river outlet works, which are lower than the penstocks, which are where water is typically released when hydropower is generated. The resulting releases from lower in the water column would be higher in total phosphorus, which may improve food web conditions given the food-limited nature of the ecosystem. The phosphorus concentrations at depth are not markedly greater than some phosphorus concentrations that have already been released under higher lake levels; therefore, no additive cumulative effect would occur from Glen Canyon Dam flow options.

The implementation of the activities as described in the US Army Corps of Engineers' EA for the implementation of the 10-Year Plan's projects for aquatic habitat restoration would continue to improve conditions.

Issue 6: How would elevation protection and low-flow conditions affect metals within each reach?

Summary

As elevations decrease, the dilution capacity of Lake Powell and Lake Mead would also decrease; however, this would not be expected to result in any significant decrease in dilution capacity or increase the concentrations of metals of concern. Quantitative metal modeling results were not available at the time of this report; therefore, only a qualitative discussion is included. Without more specific modeling, it is difficult to project the quantified water quality impacts, and alternatives cannot be compared.

No Action Alternative

Even with the projected drawdown, it is unlikely that the No Action Alternative would significantly increase the concentration of metals; this is because dilution capacity is not likely to reduce significantly. However, without more specific modeling, it is difficult to project the quantified water quality impacts.

Proposed Action

Under the Proposed Action, the dilution capacity of Lake Powell and Lake Mead would decrease; however, this would not be expected to result in any significant decrease in dilution capacity or increase the concentrations of metals of concern. Specifically, the likelihood of drawing down below 1,000 feet at Lake Mead would be small. This is similar to what was originally analyzed in the 2007 FEIS, which showed that the Lake Mead's dilution capacity did not significantly diminish between 1,178 feet and 1,000 feet. Therefore, the projected elevations and corresponding changes in dilution capacity would not be expected to result in a significant reduction in dilution capacity or any

significant increase in concentrations of metals of concern. However, without more specific modeling, it is difficult to project the quantified water quality impacts.

Cumulative Effects
The potential operational changes included in the LTEMP SEIS flow options would change how and when releases from Glen Canyon Dam take place. This would not result in any changes to monthly or annual release volumes, but it would change how and when those releases take place. Therefore, there is not an expected change to elevation that would impact metals' concentrations.

The implementation of the activities as described in the US Army Corps of Engineers' EA for the implementation of the 10-Year Plan's projects for aquatic habitat restoration would continue to improve conditions.

3.9 Air Quality

3.9.1 Affected Environment

To supplement the 2007 FEIS (Reclamation 2007), this section provides a brief summary of a more comprehensive description of the affected environment in the 2007 FEIS, supplementing, as necessary, to include changes that have occurred since 2007. For additional information, see the 2007 FEIS (Reclamation 2007) and the 2016 LTEMP FEIS (Reclamation and NPS 2016), which are incorporated by reference.

The primary air quality issue is fugitive emissions (dust) generated from shorelines exposed due to reductions in Lake Powell and Lake Mead elevations, affecting particulate levels regionally, including GCNP.

The other air quality issue, which was not addressed in the 2007 FEIS, is greenhouse gas (GHG) emissions. The alternatives analyzed may indirectly affect air quality by potentially changing the degree to which electricity demand is met within the region, with either non-emissive hydropower, wind, or solar powerplants, or emission-producing powerplants, such as fossil fuel-fired powerplants that can directly affect air quality and related resources. These air quality changes can also affect GHG emissions that can influence climate change. Therefore, dam operations can affect air quality and GHG emissions within the 11-state Western Interconnection region, which includes Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. This is because hydropower generation offsets generation from other generating facilities (that is, coal-fired and natural gas-fired facilities) in the Western Interconnection region.

LTEMP (Reclamation and NPS 2016, Table 3.15-3) presents criteria pollutant (carbon monoxide, nitrogen dioxide, ozone [O_3], particulate matter [PM_{10} and $PM_{2.5}$], sulfur dioxide, and lead), volatile organic compounds, and GHG emissions over the 11-state area within the Western Interconnection region.

Federal Air Quality Requirements

The federal air quality requirements described in the 2007 FEIS are unchanged. The determination that no major stationary sources are being proposed by the proposed alternatives and, therefore, that the statutory provisions are not applicable, is also unchanged. However, these standards still provide thresholds from which to evaluate potential effects on ambient air quality. Lake Powell, Lake Mead, and GCNP are still designated as Prevention of Significant Deterioration (PSD) Class II, Class II, and Class I areas, respectively. The PSD air quality constraints are most stringent in Class I areas and are progressively less stringent in the Class II and Class III areas; these areas have associated allowable particulate matter (PM) concentration increases over the baseline concentrations.

State and Local Air Quality Requirements

The federal and state National Ambient Air Quality Standards (NAAQS) presented in the 2007 FEIS have been updated as follows:

- NAAQS $PM_{2.5}$ annual standard (the primary standard is now 12 $\mu g/m^3$, reduced from 15 $\mu g/m^3$; the secondary standard is 15 $\mu g/m^3$).

The EPA is currently proposing to retain the current PM_{10} and $PM_{2.5}$ 24-hour standards but is considering revising the primary annual $PM_{2.5}$ standard from its current level of 12.0 $\mu g/m^3$ to within the range of 9.0 to 10.0 $\mu g/m^3$. These PM standards were promulgated to better protect the public from particulate exposures. Additionally, each state must develop an implementation plan describing how it will attain and maintain the NAAQS. Some states have developed more stringent ambient air quality standards for PM_{10} and $PM_{2.5}$, while others have adopted PM standards to meet the previous NAAQS, as follows:

- Nevada, Arizona, and Utah all now have a $PM_{2.5}$ 24-hour standard of 35 $\mu g/m^3$, and the annual PM_{10} standard has been removed.
- The California $PM_{2.5}$ 24-hour standard has been removed.

Three state and local air quality agencies are responsible for attaining the state and federal standards within the study area: Arizona Department of Environmental Quality; Utah Department of Environmental Quality, Division of Air Quality; and Clark County Air and Environmental Management.

Ambient Air Quality by River Reach

As the 2007 FEIS states, attainment status for each reach provides a qualitative characterization of compliance with the standards as well as an indication as to whether a specific pollutant is a significant concern. Consequently, characterizing the attainment status in the reaches provides a qualitative assessment of the significance of air pollutant emissions within the reach. The Arizona counties of Mohave, Coconino, Yavapai, and Navajo, and the Utah counties of Washington, Kane, and San Juan are in attainment for all pollutants. Clark County, Nevada—Las Vegas, in particular—is in attainment for all pollutants except 8-hour ozone. The attainment status has improved since the 2007 FEIS, as Clark County's PM_{10} was redesignated from nonattainment to maintenance in November 2014.

While some urban areas (including Las Vegas, North Las Vegas, and Henderson) within Clark County are maintenance areas under the PM_{10} NAAQS, the remainder of the county, including Lake Mead, is in attainment of the standard. Mohave County, Arizona, adjacent to Lake Mead, is also in attainment of the PM_{10} standard (Reclamation 2000). The Lake Powell and Glen Canyon Dam reach and Lake Mead and Hoover Dam reach are both in a PSD Class II area. As lake levels have decreased since 2007, PM due to dust has likely increased. In 2018, 24-hour PM_{10} levels at Lake Mead reached 116 $\mu g/m^3$, which is about 77 percent of the 150 $\mu g/m^3$ NAAQS. The State of Nevada started a regulatory PM_{10} monitor in Boulder City, Nevada, in 2021. In this first year of monitoring, 24-hour PM_{10} levels exceeded the 24-hour NAAQS at 190 $\mu g/m^3$, which is 127 percent of the standard. These current high levels demonstrate that dust is already a concern for the Lake Mead region; with the decreasing water levels since 2007, additional dust would affect local air quality and public health for both the Lake Powell and Glen Canyon Dam reach and Lake Mead and Hoover Dam reach.

Salton Sea

The Salton Sea is in Imperial and Riverside Counties. Imperial County is currently designated as a nonattainment area for the federal and state O_3 and $PM_{2.5}$ and maintenance for the state PM_{10} standards. Riverside County is currently designated as a nonattainment area for the federal and state O_3 and state PM_{10} standards.

Historically, the water level and therefore shoreline area at the Salton Sea have decreased from 2003 to 2015, as noted in a 2015 study (Reclamation 2023e). The decreasing water level has the potential to increase fugitive dust. The current nonattainment status of PM_{10} and $PM_{2.5}$ for these two counties demonstrates that dust is already a concern for the Salton Sea area, and additional dust would affect local air quality and public health. Particulate matter, also known as particle pollution, is a complex mixture of extremely small particles and liquid droplets. Particulate matter is made up of a number of components, including acids (such as nitrates and sulfates), organic chemicals, metals, and soil or dust particles. Particulate matter is measured and regulated according to particle size. Smaller particles are associated with more negative health effects, including respiratory and cardiovascular problems, because they can become more deeply embedded in the lungs and some may even get into the bloodstream.

3.9.2 Environmental Consequences

This section analyzes the potential effects of the proposed alternatives on air quality resources. The following issues are addressed:

- Impacts on fugitive dust from changes in shoreline exposure due to changes in lake reservoir elevations
- Impacts on GHGs from changes in hydropower generation due to changes in lake reservoir elevations and releases

Methodology

Similar to the 2007 FEIS, this analysis evaluates the relative difference between the No Action Alternative and the Proposed Action. Fugitive emissions can result from exposed sediment on the shorelines of Lake Powell and Lake Mead as a result of fluctuations in the elevations of these

reservoirs. The mass of particulates generated per acre of exposed shoreline would vary depending on sediment characteristics and other factors, such as saturation, sediment disturbance, wind speeds, and topography.

Both Lake Mead and Lake Powell have potentially experienced increased dust from newly exposed shoreline; however, neither the Glen Canyon National Recreation Area (GCNRA) nor the Lake Mead National Recreation Area (LMNRA) has current or historical air quality monitoring or modeling data to determine baseline levels. Additionally, any potential heavy metals or other contaminants in exposed sediment have not been determined due to a lack of sampling. As lake levels drop and dry out, unvegetated sediments are more likely to become airborne during wind events, causing negative impacts on air quality at localized locations due to blowing dust. Some of these areas may be at or near heavily visited marinas and beaches. The NPS advocates for deployment of air quality monitoring equipment, sediment testing, and modeling activities at both national recreation areas to appropriately inform the SEIS implementation activities prior to 2026.

To perform the shoreline exposure portion of the air quality analysis, the NPS used the 10th percentile data for the 80 percent ESP hydrologic scenario provided by Reclamation; this shows the ranges for elevations at Lake Powell and Lake Mead (NPS 2023a). In addition, geographic information system (GIS) acreage information was prepared utilizing the USGS's 2021 modified topobathymetric elevation data for Lake Powell, which is a topobathymetric digital elevation model. Topobathymetric data are a merged rendering of both topography (land elevation) and bathymetry (water depth) to provide a single product useful for inundation mapping and a variety of other applications. For a conservative assessment, the lowest extent of the 10th percentile in the 3-year period (2024, 2025, and 2026) was used to determine the elevation, inundation (acres of water), and acres of exposed shoreline at Lake Powell and Lake Mead. The results of these analyses are used throughout this section.

The way hydropower is generated has not changed since 2007. However, recent drought conditions in the Basin have led to a decrease in hydropower generation since the 2007 FEIS (Reclamation 2021d). The Glen Canyon Powerplant accounts for approximately 75 percent of the Upper Colorado Basin's annual energy production (Reclamation 2021d). Despite the improved efficiency since 2007, the Glen Canyon Powerplant has still been heavily affected by drought conditions in the Basin, and the powerplant's capacity decreases as the lake elevation drops and the head gets lower. As discussed, these reductions of power generation could result in increased GHG emissions due to coal or natural gas supplementing the otherwise non-emissive hydropower energy.

Reclamation, with the assistance of WAPA, conducted a study of the potential effects of the No Action Alternative and the Proposed Action on the Colorado River system's electrical power resources, which included all major facilities. Reclamation's CRMMS helped develop potential releases, reservoir elevations, and power generation from the Proposed Action. WAPA's GTMax modeling was used to further analyze impacts on the Glen Canyon Powerplant. GTMax simulates the dispatch of electric-generating units and the economic trade of energy among utility companies using a network representation of the power grid. Using the changes in megawatt hours (MWh) under the Proposed Action and conversion emission factors for coal and natural gas from the US Energy Information Administration's (EIA) energy conversion calculator, the estimated metric tons

(MT) of carbon dioxide equivalent (CO_2e) were calculated (EIA 2023). The results of these analyses are used throughout this section.

Impact Analysis Area

The impact analysis area for fugitive dust is the same as the analysis area used for the 2007 FEIS, which includes the Glen Canyon to Lake Mead reach; this is because the PM generated at the Lake Mead delta may be dispersed into this reach. The impact analysis area is divided into three sections: (1) Lake Powell and Glen Canyon Dam, (2) Glen Canyon Dam to Lake Mead, and (3) Lake Mead and Hoover Dam. Potential fugitive dust generated by changes to the Salton Sea's shoreline through changes in water availability are also discussed.

The analysis area includes every major hydropower facility along the Colorado River, from Lake Powell to the SIB. Facilities include the Glen Canyon Powerplant, the Hoover Powerplant, the Davis Powerplant, and the Parker Powerplant. Other smaller facilities along the river include Headgate Rock Powerplant, Senator Wash, Siphon Drop, and Pilot Knob. These smaller facilities would not be impacted by the Proposed Action and have, therefore, been removed from further analysis.

Given that climate change is a global phenomenon and the effects of GHG emissions are considered cumulative, the GHG impact analysis area would include the aforementioned 11-state Western Interconnection grid and the rest of the United States.

Assumptions

The method for assessing potential fugitive dust emissions from exposed shoreline sediments at Lake Powell and Lake Mead includes the following assumptions:

- The 10th percentile data for the 80 percent ESP hydrologic scenario provided by Reclamation show the ranges for elevations at Lake Powell and Lake Mead, including the 10 percent minimum, the 50 percent median, and the 90 percent maximum. It was assumed under the 10 percent minimum hydrology that the flows would be very low and steady year-round. For a conservative assessment, the lowest extent of the 10th percentile for the 80 percent ESP hydrologic scenario in the 4-year period was utilized.
- GIS acreage information was prepared utilizing the USGS's 2021 modified topobathymetric elevation data for Lake Powell, which is a topobathymetric digital elevation model comprised of four data sources published in 2021.
- The current Lake Powell reservoir level was retrieved from Reclamation for February 16, 2023, from the water operations 40-day data sets (Reclamation 2023f).
- The current Lake Mead reservoir level was retrieved from Reclamation for February 2023 from the end-of-the-month elevations data sets (Reclamation 2023f).
- Lake Powell inundation (acres of water) are provided for the 10th percentile for the 80 percent ESP hydrologic scenario, as well as the current level.
- Lake Mead inundation (acres of water) are calculated based on pre-inundation topographic maps for the 10th percentile for the 80 percent ESP hydrologic scenario.

- All calculations were completed using the North American Datum 1983 (2011) Universal Transverse Mercator Zone 12N projected coordinate system.

The method for assessing potential increased GHG emissions from decreased hydropower includes several assumptions made during the modeling process. The assumptions from CRMMS of the Upper and Lower Basin are covered in **Section 3.3**, Methodology, with additional information in **Section 3.6**, Hydrologic Resources. Following CRMMS of the Upper Basin, the GTMax modeling was only used for releases from Glen Canyon Dam. The modeling only analyzes penstock releases and does not analyze any potential releases from the river outlet works. Results from the GTMax modeling are only calculated for 1 week each month and then replicated for every week of the month. CRMMS estimates monthly releases in the Upper and Lower Colorado Basin. The GTMax Model estimates hourly releases at Glen Canyon Dam.

Megawatt hours derived from CRMMS and GTMax modeling were utilized. Then, using the EIA energy conversion calculators, the amount of coal and natural gas necessary to produce the same amount of power was determined. Finally, the EPA emission factors for GHG inventories were used to determine the metric tons per year (MT/year) of CO_2e for both natural gas and coal for the Proposed Action and No Action Alternative (EPA 2022).

Impact Indicators

Impact indicators for air quality would remain the same as previously considered for the 2007 FEIS, including fugitive dust from shoreline exposure. In addition, impact indicators for air quality would include GHG emissions from alternative power sources (coal and natural gas) due to reduced hydropower. Reservoir elevation changes determine the amount of head available, which determines both energy and capacity, and penstock water releases are what power the powerplant turbines and lead to power generation.

Issue 1: How would changing flow characteristics affect the potential exposed shoreline and fugitive dust?

Summary

The projected exposed shoreline acreages under the Proposed Action are less than those projected under the No Action Alternative at Lake Powell. The projected exposed shoreline acreages under the Proposed Action are also less than those projected under the No Action Alternative at Lake Mead.

As reservoir elevations decrease and more shoreline is exposed, the potential for increased fugitive dust emissions increases. There is also a significant potential for local "dust devils" and/or regional haboobs (intense dust storms), exposure to toxins in dust, and associated human health effects. With decreasing water levels, additional dust would affect local air quality and public health.

Without years of baseline monitoring for PM within the impact reach, changes in fugitive dust emissions would be difficult to determine. However, documentation of dust emissions has been studied at other western United States state and national parks in hopes of developing wind erosion vulnerability maps at local to regional scales. This documentation has characterized the physical and

chemical properties of dust to better understand how dust influences atmospheric properties, ecosystem functions, and human health.

Although not included in this assessment, the application of mitigation strategies may also be needed due to local and regional dust impacts, including, but not limited to, mapping riparian areas for the highest potential restoration opportunities, implementing managed vegetation, allowing for shallow flooding that also affects river dynamics and HFEs, and conducting annual tillage methods and graveling. The National Resource Conservation Service is currently surveying soil content for other drying lakeshores, such as the Salton Sea in California, to formulate a dust risk index and to provide insight into potential airborne toxins and effects on human health.

No Action Alternative

Under the No Action Alternative, the 2007 Interim Guidelines and subsequent agreements would continue to guide operations in Glen Canyon Dam to the Lake Mead reach. Releases from Lake Powell under poor hydrologic conditions would deplete Lake Powell, exposing a large acreage of increased shoreline at Lake Powell. The stage of water in the river would likely decrease from Glen Canyon Dam to Lake Mead, but it would have comparatively little impact on dust issues. As water elevations continue to decline in Lake Powell, less water would be available for releases below this reach; this could result in additional air quality impacts at Lake Mead.

Lake Powell and Glen Canyon Dam

Under the No Action Alternative, the 2007 Interim Guidelines and subsequent agreements would continue to guide operations in Lake Powell. The current Lake Powell elevation is 3,573 feet, and Lake Powell surface is 57,454 acres. Snowpack and hydrology may change water levels and exposed shorelines dramatically over a broad range. In the case of the No Action Alternative 10th percentile for the 80 percent ESP hydrologic scenario (2023–2026), increased dust would be noted with much larger shorelines at Lake Powell, with an estimated exposure of an additional 28,000 acres. In the 2007 FEIS, the low Lake Powell elevation at the 10th percentile was projected for the year 2025 with about 17,000 acres of exposed shoreline (Reclamation 2007, Figure 4.6-1 and Table 4.6-1).

Glen Canyon Dam to Lake Mead, Lake Mead and Hoover Dam

The current Lake Mead elevation is 1,047 feet, which covers 10,636 acres. Snowpack and hydrology will change water levels and exposed shorelines dramatically over a broad range. In the case of the No Action Alternative 10th percentile for the 80 percent ESP hydrologic scenario (2023–2026), increased dust would be noted with much larger shorelines at Lake Mead, with an estimated exposed additional 94,350 acres. In the 2007 FEIS under the No Action Alternative, Lake Mead's elevation would be drawn down to 1,003 feet for 2025, resulting in approximately 89,000 acres of exposed shoreline (Reclamation 2007, Figure 4.6-2 and Table 4.6-2).

Proposed Action

Under the Proposed Action, potentially more shoreline would be exposed compared with under the No Action Alternative. Lake Powell's projected pool elevations are expected to be the same as under the No Action Alternative. Lake Mead's pool elevation would remain around 1,050 feet through 2024 and then would dip to approximately 1,025 feet. The increase in exposed shoreline would potentially have a negative effect on air quality. The increase in acreage susceptible to wind erosion

could contribute to an exceedance of the PSD Class II threshold or the state or national air quality standards.

Salton Sea

As noted above, the Salton Sea receives flows from excess irrigation drainage, particularly from the IID and CVWD. Under the No Action Alternative, there would be no changes to current operational activities that would affect flows to the IID or CVWD. Therefore, the Salton Sea's current shoreline area could continue to decrease at the current rate. Projected exposed playa at the Salton Sea for both the Salton Sea Restoration and Renewable Energy Initiative (SSRREI) and Perimeter Lake alternatives show exposed playa will continue to increase as elevation decreases through 2047 and then stabilize. The SSRREI and Perimeter Lake alternatives were concepts proposed as early as 2015 and the long-term restoration options included in these concepts have not yet been approved into final plan. Total exposed playa in all alternatives is projected to approach 100,000 acres by around 2047 and stabilize consistent with the elevation results. The mean elevation in 2018 was 20,549; in 2047, the mean elevation is projected to be 100,303 acres. The SSRREI alternative gradually converts some newly exposed playa into wetland habitat. The Perimeter Lake alternative covers some of the exposed playa when the lake levees are completed. Both alternatives have similar final exposed playa areas at build-out and are similar to the No Action Alternative in terms of total playa area that may need to be managed for air quality impacts.

Under the Proposed Action, there is the possibility that the IID and CVWD could take additional shortages; thus, there could be reduced river flows and thus potentially less inflow to the Salton Sea from irrigation drainage. Based on modeling, the Salton Sea water surface elevation will decline more rapidly under the Proposed Action than under the No Action Alternative due to additional consumptive uses on the playa (either shallow water habitat or perimeter lake). While the water surface elevation of the habitat and perimeter lake are stabilized under the alternatives, the Salton Sea water surface elevation is projected to decline by about 4 feet, as compared with under the No Action Alternative, by 2047. Projected playa exposure may be greater under the Proposed Action, but by 2047, it is projected to be the same as under the No Action Alternative.

Furthermore, while the No Action Alternative has the slowest decline in water surface elevation, it does not provide replacement habitat for that being lost at the Salton Sea. However, both anticipate an increase in exposed shoreline. This increase would potentially have a negative effect on air quality because the decreasing water level would increase fugitive dust. Since dust is already a concern for the Salton Sea area, additional dust would affect local air quality and public health. The mass of particulates generated per acre of exposed shoreline would vary depending on sediment characteristics and other factors, such as saturation, sediment disturbance, wind speeds, and topography.

Cumulative Effects

The cumulative effects are the impacts of the proposed alternatives combined with other regional water supply or closely related projects in the region. If one of the LTEMP SEIS flow options were implemented, water would be released through the river outlet works. This would have no cumulative effect on fugitive dust air quality emissions. The operating tiers established by this SEIS will determine annual release volumes in the LTEMP SEIS. The LTEMP SEIS includes two

elements: smallmouth bass flow options and a potential adjustment to HFE sediment account periods and implementation windows. The smallmouth bass flow options would result in temporary changes to daily and hourly flows, which would not impact air quality. Therefore, the potential change of smallmouth bass flow options would result in no changes to annual or monthly reservoir levels in Lake Powell or Lake Mead and would not impact air quality.

Finally, no additive cumulative effects would occur on air quality due to the proposed management activities planned in the Salton Sea 10-Year Plan or the environmental assessment for the implementation of the 10-Year Plan's projects. No cumulative impacts would result as the Proposed Action is not adding additional impacts to those that are already occurring; however, these impacts might occur sooner under the Proposed Action.

Issue 2: How would lake reservoir elevations and releases impact power generation and GHG emissions?

Summary

Compared with the No Action Alternative, the Proposed Action would result in varying degrees of impacts on power generation. In 2024, the Proposed Action outperforms the No Action Alternative under all but the wettest hydrologic conditions; however, the differences in 2024 are minimal when compared to the total hydropower generation. The Proposed Action would result in more power generation compared with the No Action Alternative under low hydrologic scenarios. This is particularly true in 2026, when the No Action Alternative has the potential for dropping below minimum power pool. Annual releases at Lake Mead are higher under the No Action Alternative, leading to less power generation at Hoover Powerplant than under the Proposed Action across most hydrologic scenarios.

The difference between the power generated for the No Action Alternative and the Proposed Action is 316,826 MWh in 2024, 129,988 MWh in 2025, and 139,567 MWh in 2026. The GHG emissions under the Proposed Action for both coal and natural gas were calculated and compared with both total 11-state GHG emissions at 1,226.3 million MT CO_2e in 2010 and total US GHG emissions at 6,810.3 million MT CO_2e in 2010 (Reclamation and NPS 2016) (**Table 3-23**). Increases in GHG emissions under the Proposed Action compared with the No Action Alternative would be small, at approximately 108,329 MT/year of CO_2e for coal and 62,500 MT/year of CO_2e for natural gas. However, the totality of climate change impacts is not attributable to any single action. Albeit a small contribution, this project-related increase in emissions, in combination with a variety of global GHG emission sources, could exacerbate climate-related impacts.

Reservoir surfaces (and their drawdown areas) also can be potent emitters of GHGs. A preliminary survey at Lake Powell suggests relatively low surface water emissions (Waldo et al. 2021) but the role of drawdown emissions from deltaic sediments may be significant when water levels drop (see Malenda et al. 2020). Due to uncertainty, these GHG emissions have not been quantified.

Table 3-23
Reduction of Annual Energy Generation and Associated GHG Emissions

Measure	No Action Alternative 10th Percentile	Proposed Action 10th Percentile
2024 Total - Glen Canyon, Hoover, and Parker-Davis Generation (MWh)	7,387,918	7,071,092
2025 Total - Glen Canyon, Hoover, and Parker-Davis Generation (MWh)	7,069,272	6,939,285
2026 Total - Glen Canyon, Hoover, and Parker-Davis Generation (MWh)	6,806,870	6,667,303
Largest Difference in MWh from No Action Alternative	581,048	316,826
Coal - Mixed (Electric Power Source) (MT/year CO2e)	198,672	108,329
% of 11-State GHG Emissions	0.01	0.009
% of US GHG Emissions	0.003	0.002
Natural Gas (MT/year CO2e)	114,622	62,500
% of 11-State GHG Emissions	0.01	0.005
% of US GHG Emissions	0.001	0.0009

No Action Alternative

As discussed in **Section 3.6.2**, Hydrologic Resources, under the No Action Alternative, annual releases from Lake Powell and Lake Mead would continue in the Lower Elevation Balancing Tier, as outlined in the 2007 Interim Guidelines. At these rates, under the driest hydrologic conditions, there is a potential for water elevations to drop below the minimum power pool at Lake Powell. There were no modeled outcomes that resulted in reservoir elevations at Lake Mead dropping below minimum power pool. Any drop below the power pool could potentially change the degree to which electricity demand is met within the region with either non-emissive hydropower, wind, or solar powerplants, or emission-producing powerplants, such as fossil fuel-fired powerplants that can directly affect air quality and related resources. These air quality changes can also affect GHGs that can influence climate change.

Section 3.6.2, Hydrologic Resources, also includes tables showing the analyses for annual energy generation at the Glen Canyon, Hoover, Parker, and Davis Powerplants for the 2024–2026 year and the likelihood of lake elevations dropping below the minimum power pool at all major powerplants. The 10th percentile of the modeled annual generation values from these tables were selected. **Table 3-23**, above, presents the 10th percentile modeled annual generation values for the No Action Alternative.

Proposed Action

Under the Proposed Action, the calculated GHG emission increases are compared with both total 11-state GHG emissions at 1,226.3 million MT CO2e in 2010 and total US GHG emissions at 6,810.3 million MT CO2e in 2010 (Reclamation and NPS 2016) (**Table 3-23**). Under the Proposed Action, the reduction of hydropower could result in GHG emissions of 108,329 MT/year (0.108 million MT/year) with coal as the replacement power source, or 62,500 MT/year (0.0625 million MT/year) with natural gas as the replacement power source. Differences in GHG emissions from the Proposed Action range from 0.009 percent (coal) to 0.005 percent (natural gas) relative to total 11-state GHG emissions, and from 0.002 percent (coal) to 0.0009 percent (natural gas) relative to total US GHG emissions.

Cumulative Effects

GHG emissions are inherently cumulative impacts because climate change is a global problem, and the emissions from any single project alone would be negligible. The cumulative impacts are the impacts of the proposed alternatives combined with other regional water supply or closely related projects in the region. If one of the LTEMP SEIS flow options were implemented, water would be released through the river outlet works that do not include power generation. This could result in a cumulative negative impact on power generation across both alternatives outlined in this SEIS. The changes in sediment account windows could have impacts on power generation at the Glen Canyon Powerplant.

HFEs at different times of year could result in some impacts on generation. These impacts would not be outside the range analyzed in LTEMP. However, annual volume releases from Lake Powell would not change under the LTEMP SEIS; therefore, no additional impacts would occur at any downstream powerplants. HFEs at different times of year could result in some impacts on generation. These impacts would not be outside the range analyzed in LTEMP. However, annual volume releases from Lake Powell are not anticipated to change under the LTEMP SEIS; therefore, no additional impacts are anticipated at any downstream powerplants. The impacts on hydropower would potentially increase GHG emissions due to more emissive alternative power sources, such as coal and natural gas. This would result in a cumulative negative impact on generation across the Proposed Action. However, when calculated, the potential GHG emissions from coal and natural gas alternatives are a very small percentage of the 11-state and US GHG emissions.

No cumulative effects would occur on power generation and GHG emissions due to the proposed management activities planned in the Salton Sea 10-Year Plan or the environmental assessment for the implementation of the 10-Year Plan's projects. No cumulative impacts would result as the Proposed Action is not adding additional impacts to those that are already occurring; however, these impacts might occur sooner under the Proposed Action.

3.10 Visual Resources

3.10.1 Affected Environment

Visual resources are the physical features that make up the visible landscape, including land, water, vegetation, topography, and human-made features such as buildings, roads, utilities, and structures. They also include the response of viewers to those features. This SEIS builds on the 2007 FEIS (Reclamation 2007), which identified the following visual resource issues that may be affected by the No Action Alternative and Proposed Action:

- Attraction features
- Extent (height) of visible calcium carbonate ring
- Exposure of sediment deltas at reservoir inflow areas

Additionally, under this SEIS, based on proposed changes to the flow rate of the Colorado River between Glen Canyon Dam and Lake Mead, as well as potential changes in water availability in the Lower Division States, the following visual resource issues may also be affected:

- Landscape character adjacent to the Colorado River between Glen Canyon Dam and Lake Mead, including through the Grand Canyon
- Broader landscape modifications from reduced water availability, including in irrigated, agricultural landscapes within the Lower Division States

Lake Powell and Glen Canyon Dam Reach

Attraction Features

The landscapes of the Lake Powell and Glen Canyon area are characterized by sweeping vistas of red rock towers, buttes, and mesas typical of the Colorado Plateau (Fenneman 1931). The presence of Navajo Sandstone and desert varnish dominates the existing landscape character with the introduction of water, associated with Lake Powell, framing these natural features. The 2007 FEIS identified three attraction features:

- **Rainbow Bridge**: Contained within Rainbow Bridge National Monument, established in 1910, it was originally only accessible via the rugged Wetherill Trail from Navajo Mountain. Today, no facilities support visitation to Rainbow Bridge National Monument. All infrastructure (docks and restrooms) were relocated to the main channel in 2021, due to narrowing of the canyon and a delta that has formed at the back of the canyon. Some small, motorized vessels may be able to access the monument; however, they must beach their boat, and the walk may be through very soft sediment to reach the trail. Based on lower lake elevations, visitors do not see water under or near the Rainbow Bridge. Therefore, while Rainbow Bridge is an important visual resource, the potential impacts on access would be the primary effect on visitors, which are described in **Section 3.14**, Recreation.
- **Cathedral in the Desert**: This feature was inundated by the waters of Lake Powell as the reservoir filled. This feature is only exposed at lower Lake Powell elevations, and it is completely visible and accessible when reservoir elevations are below 3,550 feet. However,

boats may not be able to reach it at reservoir elevations below 3,525 feet. Note, other attraction (geological) features including Gregory Bridge, La Gorce Arch, and other features inundated by Lake Powell could also become visible at lower lake elevations.

- **Glen Canyon Dam**: The American Society of Civil Engineers considers this dam one of the finest examples of concrete, thin-arch dams in the United States.

Calcium Carbonate Rings

As described in the 2007 FEIS, Lake Powell has deposits of calcium carbonate, which become visible as reservoir levels decrease. At lower lake elevations, the colorful sandstone canyon walls show a white band of calcium carbonate deposit between the full reservoir elevation and the lower reservoir elevation, which contrast with the natural, red-colored sandstone. At lower lake elevations, motorists view the calcium carbonate ring on Utah State Route 95 (near Hite, Utah), boaters view it on Lake Powell, recreationists see it at developed and undeveloped recreation areas (for example, Hite, Bullfrog, Halls Crossing, Antelope Point, and Wahweap), and hikers see it on trails adjacent to Lake Powell.

Sediment Deltas

As described in the 2007 FEIS, sediment deltas appear as expansive, deep, and eroding mud flats cut by river channels. Sediment exposed for more than a few months is soon colonized by tamarisk, an invasive shrub. Sediments carried by the Colorado River and the San Juan, Dirty Devil, and Escalante Rivers are deposited near the inflow areas of Lake Powell, forming downstream-progressing deltas. These sediment deltas are considered a visual distraction, particularly as the reservoir elevation decreases and the deltas become more visible. The sediment deltas can be seen from viewing areas, including Utah State Route 95 (Utah Bicentennial Scenic Byway) and scenic overlooks adjacent to these inflow areas; water-based recreationists can also see the deltas on Lake Powell.

Glen Canyon to Lake Mead

Attraction Features

This portion of the river, including GCNP, is heavily visited. It includes world-renowned whitewater rafting and other recreational opportunities along the Colorado River (see **Section 3.14**, Recreation, for more information).

Calcium Carbonate Rings

This portion of the Colorado River does not include visible calcium carbonate rings, as it is not contained within an area of fluctuating reservoir levels (such as Lake Powell or Lake Mead).

Sediment Deltas

This portion of the Colorado River does not include sediment deltas, as described for Lake Powell and Lake Mead.

Colorado River Landscape Character

The existing landscape character along the Colorado River is defined by towering cliff faces with banded rock strata containing a variety of colors, including reds, oranges, grays, browns, and white. Vegetation along the river mostly consists of riparian species, such as native willows; nonnative and

invasive tamarisk (salt cedar); and isolated areas of cottonwoods and cattails, bulrushes, and reeds in return-current channels (backwaters), channel margins, and mouths of tributary streams from Glen Canyon Dam downstream to Lake Mead. These tributary streams form numerous side canyons leading away from the Colorado River, with many of these side canyons only accessible from the river.

Vegetation farther upslope along rock terraces includes saltbush, arrowweed, rabbitbrush, and other arid-adapted plant species. Previously planned and implemented HFEs from Glen Canyon Dam, to re-create natural floods common before Glen Canyon Dam's construction, have allowed for the transportation and deposition of sand, resulting in the formation of sandbars along the river. In some areas, these HFEs can strip vegetation along the existing sandbars, including tamarisk (salt cedar), which allows the landscape to appear more similar to its natural character.

Lake Mead to Hoover Dam

Attraction Features

The Lake Mead and Hoover Dam area landscapes are similar to those described for the Lake Powell area, except the adjacent landscapes are more typical of the Basin and Range physiographic province, characterized by parallel, north–south-oriented mountain ranges surrounded by nearly level, typically undrained basins (Fenneman 1931). The 2007 FEIS identified one attraction feature:

- **Hoover Dam**: Hoover Dam is a major destination and national landmark with high levels of visitation. In 1955, the American Society of Civil Engineers selected it as one of the seven engineering wonders in the United States. Since the Hoover Dam is in the narrow, steep-walled Black Canyon, only a small portion of Lake Mead is visible from Hoover Dam and adjacent visitor facilities.

Calcium Carbonate Rings

Similar to Lake Powell and as described in the 2007 FEIS, Lake Mead also has deposits of calcium carbonate, which become visible as reservoir levels decrease. At lower lake elevations, the steep rock slopes, canyon walls, and islands show a white band of calcium carbonate deposit between the full reservoir elevation and the lower reservoir elevation, which contrasts with the natural rock colors. At lower lake elevations, motorists view the calcium carbonate ring on US Highway 93 (between Boulder City, Nevada, and Hoover Dam), boaters view it on Lake Mead, and hikers see it on trails adjacent to Lake Mead.

Sediment Deltas

As described in the 2007 FEIS, sediment deltas have built up at the confluence of the Virgin River and Muddy River at the upper Overton Arm and at upper Lake Mead (Iceberg Canyon, Pearce Basin, and lower Granite Gorge). Sediment deltas are visible primarily to water-based recreationists. Visitors to LMNRA at Overton Beach and Pearce Ferry can also view them.

Broader Landscape Character

Availability of water from the Colorado River has resulted in large areas of irrigated landscapes, including agricultural lands in Nevada, Arizona, and California (Lower Division States), which have altered the existing, natural landscapes. This increased water availability has introduced vivid greens

into these landscapes, associated with crops and ornamental plantings, which expand the influence of the Colorado River into adjacent arid lands beyond the narrow, natural riparian corridor. Irrigated landscapes also include lands adjacent to the Salton Sea, which the US Bureau of Land Management (BLM) inventoried as part of the Palm Springs-South Coast and El Centro Field Office's BLM visual resource inventories; the BLM determined these lands contain low to moderate scenic quality, except for the Dos Palmas area, which was inventoried as possessing a high level of existing scenic quality (BLM 2010a, 2010b). Views of potential changes to the shoreline of the Salton Sea, through adjustments in water management, would be visible from the Salton Sea State Recreation Area, Salton Sea National Wildlife Refuge, multiple California state routes (State Routes 78, 86, and 111), and adjacent residential areas.

3.10.2 Environmental Consequences

Methodology

Reclamation used similar methods for the analysis of potential impacts on visual resources as were used in the 2007 FEIS to assess the effects on attraction features, extent of the visible calcium carbonate ring, and exposure of sediment deltas at reservoir inflow areas. Based on lowering lake levels associated with Lake Powell, at and below 3,550 feet, the analysis of effects on attraction features assumes the Cathedral in the Desert may be visible (and accessible) under both the No Action Alternative and the Proposed Action.

The assessment of effects on landscape character adjacent to Lake Powell and Lake Mead used the same methods identified in the 2007 FEIS. These include using the latest 80 percent ESP analysis's 10th percentile reservoir elevations, developed by Reclamation using CRMMS, with March 2025 selected for Lake Powell and September 2025 selected for Lake Mead. The height of the calcium carbonate ring was calculated as the distance in feet from full pool elevations of Lake Powell (3,700 feet) and Lake Mead (1,221 feet) to the applicable 10th percentile reservoir elevation. The assessment of effects from sediment deltas considers these 10th percentile reservoir elevations and tiers to the analysis conducted in the 2007 FEIS.

Reclamation added two new analysis items, the Colorado River landscape character and broader landscape character, based on changes in hydrologic conditions associated with the No Action Alternative as well as management direction associated with the Proposed Action. To assess potential changes to the landscape character along the Colorado River (between Glen Canyon Dam and Lake Mead), this analysis focuses on a qualitative assessment of effects associated with lower flow rates and the potential inability to conduct HFEs from Glen Canyon Dam. This analysis considers and references the analyses contained in **Section 3.13**, Riparian Vegetation portion of Biological Resources, and **Section 3.14**, Recreation, which assess the effects of the different flow rates resulting from both alternatives on the prevalence of riparian vegetation and the visibility of river features, including Separation and Pearce Ferry rapids, respectfully.

The assessment of potential impacts on the broader landscape character in the Lower Division States considered changes in annual Colorado River water supplies available to these states to identify the extent of large-scale changes to the visual character in irrigated landscapes, including those associated with agricultural production, as well as potential changes to the Salton Sea's

shoreline through changes in water availability. This analysis considers and references assessment items contained in **Section 3.16**, Socioeconomics, including the effect of each alternative's proposed distribution of water on agricultural operations in these areas.

Impact Analysis Area

The visual resource impact analysis area was defined as the area within 5 miles of the Colorado River and full pool elevations of Lake Powell and Lake Mead. The 2007 FEIS did not specifically identify an analysis area for visual resources; however, based on the typical threshold between the foreground, middle ground, and background visual distance zones where views of the change in management could attract attention in the landscape, this analysis area was selected to facilitate the assessment of the most intense potential impacts. Visual effects beyond this geographic area were considered, where appropriate, including the effects on the broader landscape character associated with potential decreased water availability for the Lower Division States, including potential changes to the Salton Sea's shoreline.

Assumptions

- The analysis methods are consistent with the 2007 FEIS. Based on lowering water levels associated with Lake Powell, the assessment of visibility and access to Cathedral in the Desert assumes Cathedral in the Desert would become visible and accessible under both alternatives.
- Deceasing flow rates along the Colorado River, and the inability to conduct HFEs from Glen Canyon Dam, would modify the river corridor's natural, visual character by limiting natural flooding processes, including through the Grand Canyon.
- Decreasing water availability for the Lower Division States would result in large-scale changes to the visual character in irrigated landscapes, including those associated with agricultural production.

Impact Indicators

- **Attraction Features:** Qualitative assessment describing the effects from continued visibility and access to Cathedral in the Desert as well as more of Glen Canyon Dam and Hoover Dam becoming visible on their upstream side, tiering to the results from the 2007 FEIS and considering current reservoir elevations and the latest 80 percent ESP analysis's 10th percentile reservoir elevations.
- **Calcium Carbonate Rings:** Potential height (in feet) of the calcium carbonate rings at Lake Powell and Lake Mead for each alternative, considering the latest 80 percent ESP analysis's 10th percentile reservoir elevations.
- **Sediment Deltas:** Qualitative assessment tiering to the analysis from the 2007 FEIS, considering the latest 80 percent ESP analysis's 10th percentile reservoir elevations.
- **Colorado River Landscape Character:** Qualitative description of the effect associated with proposed flow rates and the potential to conduct HFEs from Glen Canyon Dam under each alternative, considering modeling associated with **Section 3.13**, Riparian Vegetation portion of Biological Resources, and **Section 3.14**, Recreation.
- **Broader Landscape Character:** Qualitative description of the effects associated with potential decreases in water availability for the Lower Division States on the broader

landscape character. This includes considering modeling associated with potential changes to crop production as a result of proposed distribution of water, as described in **Section 3.16**, Socioeconomics, as well as modeling for the Salton Sea depicting the projected exposed lakebed area associated with different drought-reduction scenarios.

Issue 1: How would management of reservoir elevations affect the visibility of attraction features?

Summary

Visibility and access to Cathedral in the Desert, and other attraction features inundated by Lake Powell, would be similar among both alternatives. Due to lower projected elevations for Lake Powell and Lake Mead associated with the No Action Alternative, more of the upstream side of Glen Canyon and Hoover Dams would be visible compared with under the Proposed Action.

No Action Alternative

Under the No Action Alternative, Lake Powell could drop below 3,550 feet during the planning period through the end of 2026. Based on lake elevations potentially dropping below this threshold, Cathedral in the Desert and other attraction features inundated by Lake Powell could be visible and accessible under the No Action Alternative during the planning period. This same modeling projects pool elevations for Lake Powell could drop below 3,500 feet through 2026, which would expose more of the upstream side of Glen Canyon Dam. The impacts associated with more of Glen Canyon Dam becoming visible would be similar to the effects described in the 2007 FEIS. Similarly, more of the upstream side of Hoover Dam would become visible due to lowering lake elevations in Lake Mead, which based on modeling, would approach and may drop below 1,000 feet in 2026.

Proposed Action

Similar to the No Action Alternative, Cathedral in the Desert and other attraction features inundated by Lake Powell could be visible and accessible under this alternative. Based on proposed management to maintain Lake Powell at 3,500 feet or above, less of the upstream side of Glen Canyon Dam would be exposed under this alternative. In a similar manner, through management of Lake Mead, water levels would remain above 1,000 feet through 2026; this would result in less of the upstream side of Hoover Dam becoming visible under this alternative compared with under the No Action Alternative.

Cumulative Effects

The LTEMP SEIS includes two elements: smallmouth bass flow options and a potential adjustment to HFE sediment account periods and implementation windows. The smallmouth bass flow options would result in temporary changes to daily and hourly flows, which would not impact reservoir levels or visibility of attraction features. The potential adjustment to HFE sediment accounting periods and implementation windows could result in changes in the timing of HFEs, which could minimally affect monthly reservoir levels in Lake Powell and Lake Mead. These differences are expected to be minor, temporary, and resolved by the end of the operational year and would result in no changes to annual reservoir levels or visibility of attraction features. Therefore, no additive cumulative effects would occur on attraction features, and effects would be the same as described above for each alternative.

Future increases in consumptive use of Colorado River water in the Upper Division States, intrastate water transfers in the Lower Division States (e.g., Quantification Settlement Agreement water transfers), implementation of the Lower Colorado River Multi-Species Conservation Plan (LCR MSCP), and various requirements and constraints applied to the operation of the Colorado River system were included in modeling of future system conditions.

No cumulative effects would occur on attraction features from the proposed management activities planned in the Salton Sea 10-Year Plan or the environmental assessment for the implementation of the Salton Sea 10-Year Plan's projects. No cumulative impacts would result as the Proposed Action is not adding additional impacts to those that are already occurring; however, these impacts might occur sooner under the Proposed Action.

Issue 2: How would management of reservoir elevations affect the landscape character, including the visibility of calcium carbonate rings and sediment deltas?

Summary

The effects on the landscape character associated with the visibility of calcium carbonate rings and sediment deltas would be more prominent under the No Action Alternative. This is due to taller calcium carbonate rings and more extensive sediment deltas, which would become populated by vegetation, including tamarisk. This vegetation would introduce bright greens into the landscape that would contrast with the arid landscape's natural character. These changes in landscape character would be visible to boaters on Lake Powell and Lake Mead, motorists on adjacent highways, and recreationists at developed and undeveloped recreation areas.

No Action Alternative

Modeled reservoir elevations for March 2025 indicate a low Lake Powell reservoir elevation of 3,504 feet under the No Action Alternative. This would create a potential calcium carbonate ring that would be 196 feet in height. Modeled reservoir elevations for September 2025 indicate a low Lake Mead reservoir elevation of 1,017 feet under the No Action Alternative. This would create a potential calcium carbonate ring that would be 204 feet in height. As described in the 2007 FEIS, sediment deltas would continue to build up over time and would be visible as the reservoir elevations drop, including under the No Action Alternative. The expanding sediment deltas would become populated by vegetation, including tamarisk, which would introduce bright greens into the landscape that contrast with the arid landscapes adjacent to Lake Powell and Lake Mead.

Both the calcium carbonate ring and sediment deltas would modify the landscape character along the edge of Lake Powell. These modifications would be visible for motorists on Utah State Route 95, boaters on the Lake Powell, recreationists at developed and undeveloped recreation areas, and hikers on trails adjacent to Lake Powell. Similarly, the calcium carbonate ring and sediment deltas would modify the landscape character along the edge of Lake Mead; these modifications would be visible for motorists on US Highway 93 (between Boulder City, Nevada, and the Hoover Dam), boaters on Lake Mead (including visitors to Overton Beach and Pearce Ferry), and hikers on trails adjacent to Lake Mead.

Proposed Action

Modeled reservoir elevations for March 2025 indicate a low Lake Powell reservoir elevation of 3,510 feet under the Proposed Action. This would create a potential calcium carbonate ring that would be 190 feet in height. Modeled reservoir elevations for September 2025 indicate a low Lake Mead reservoir elevation of 1,037 feet under the Proposed Action. This would create a potential calcium carbonate ring that would be 184 feet in height. Based on potential higher lake elevations under this alternative, the sediment deltas would be less extensive than under the No Action Alternative. Due to the shorter calcium carbonate ring and less extensive sediment deltas, the Proposed Action would result in less modification to the landscape character along the edge of Lake Powell and Lake Mead, including impacts on viewers, than the No Action Alternative.

Cumulative Effects

The LTEMP SEIS includes two elements: smallmouth bass flow options and a potential adjustment to HFE sediment account periods and implementation windows. The smallmouth bass flow options would result in temporary changes to daily and hourly flows, which would not impact reservoir levels or the landscape character near Lake Powell and Lake Mead. The potential adjustment to HFE sediment accounting periods and implementation windows could result in changes in the timing of HFEs, which could minimally affect monthly reservoir levels in Lake Powell and Lake Mead. These differences are expected to be minor, temporary, and resolved by the end of the operational year; they would result in no changes to annual reservoir levels or the adjacent landscape character. Therefore, no additive cumulative effects would occur on the landscape character near Lake Powell and Lake Mead with the same effects described above occurring for each alternative.

Future increases in consumptive use of Colorado River water in the Upper Division States, intrastate water transfers in the Lower Division States (e.g., Quantification Settlement Agreement water transfers), implementation of the LCR MSCP, and various requirements and constraints applied to the operation of the Colorado River system were included in modeling of future system conditions.

No cumulative effects would occur on the landscape character near Lake Powell and Lake Mead from the proposed management activities planned in the Salton Sea 10-Year Plan or the environmental assessment for the implementation of the 10-Year Plan's projects. No cumulative impacts would result as the Proposed Action is not adding additional impacts to those that are already occurring; however, these impacts might occur sooner under the Proposed Action.

Issue 3: How would management of releases from Glen Canyon Dam affect landscape character along the Colorado River?

Summary

The No Action Alternative would initially have less impacts on the landscape character than the Proposed Action. This is because the No Action Alternative does not include reducing flows below 7.0 maf; however, if Lake Powell were to drop to dead pool, these impacts would be more extensive and immediate compared with under the Proposed Action. Under the Proposed Action, the different release tiers would temper these impacts with the goal of maintaining consistent flows along the Colorado River (including through the Grand Canyon) while keeping Lake Powell above 3,500 feet.

No Action Alternative

The No Action Alternative includes lowering releases from Glen Canyon Dam as Lake Powell elevations drop; this would result in releases as low as 7.0 maf when elevations drop below 3,525 feet. Since the No Action Alternative does not include reducing releases from Glen Canyon Dam under 7.0 maf, including if Lake Powell drops below power pool but remains above dead pool, there would be minor, incremental impacts on the landscape character along the Colorado River, including through the Grand Canyon. The current trends of increasing bank armoring, associated with expanding riparian vegetation areas (including tamarisk), would continue under the No Action Alternative.

Based on the current 80 percent ESP modeling, it is not anticipated that Lake Powell would reach dead pool elevation during the planning period. If the elevation of Lake Powell were to drop below dead pool, flows from Glen Canyon Dam could dramatically decrease, resulting in more extensive impacts on the landscape character, including the appearance of river features previously not visible under current conditions. Additionally, the positive influence of the moving, turbulent Colorado River adds to the existing landscape character, which would be degraded if releases from Glen Canyon Dam would be dramatically reduced. (For more information on the impacts on riparian vegetation under the No Action Alternative, refer to **Section 3.13**, Biological Resources; for impacts on recreation, including visibility of river features, refer to **Section 3.14**, Recreation.)

Proposed Action

The Proposed Action, as part of the Mid-Elevation Release Tier (below 3,575 feet) and Lower Elevation Balancing Tier (below 3,525 feet), includes a series of thresholds to reduce releases from Glen Canyon Dam. These thresholds are tied to lowering Lake Powell elevations with a release limited to 6.0 maf, if Lake Powell elevation projections show Lake Powell could drop below 3,500 feet during the subsequent 12 months. Lower releases from Glen Canyon Dam would result in less water flowing along the Colorado River (and through the Grand Canyon), which could increase existing trends of bank armoring associated with more extensive riparian vegetation, including tamarisk. Lower releases also could limit the number of times a HFE could be triggered from Glen Canyon Dam, which would only occur when the HFE furthers maintenance of target reservoir elevations. These lower flows may also result in the appearance of river features previously not visible under current conditions and less movement of the river's natural sandbars.

If the yearly elevation projection identifies that Lake Powell would be above 3,500 feet, resulting in releases of 7.0 maf or more, the impacts associated with this alternative would be similar to those described under the No Action Alternative as the increased impacts associated with the lower 6.0 maf releases from Glen Canyon Dam would be avoided. (For more information on the impacts on riparian vegetation under the Proposed Action, refer to **Section 3.13**, Biological Resources; for impacts on recreation, including visibility of river features, refer to **Section 3.14**, Recreation.)

Cumulative Effects

The LTEMP SEIS includes two elements: smallmouth bass flow options and a potential adjustment to HFE sediment account periods and implementation windows. The smallmouth bass flow options would result in temporary changes to daily and hourly flows, which would not impact reservoir levels or the landscape character along the Colorado River downstream of Glen Canyon Dam. The

potential adjustment to HFE sediment accounting periods and implementation windows could result in changes in the timing of HFEs, which could minimally affect monthly reservoir levels in Lake Powell and Lake Mead. These differences are expected to be minor, temporary, and resolved by the end of the operational year; they would result in no additive cumulative effects on the landscape character along the Colorado River, with the same effects described above occurring for each alternative.

Future increases in consumptive use of Colorado River water in the Upper Division States, intrastate water transfers in the Lower Division States (e.g., Quantification Settlement Agreement water transfers), implementation of the LCR MSCP, and various requirements and constraints applied to the operation of the Colorado River system were included in modeling of future system conditions.

No cumulative effects would occur on the landscape character along the Colorado River from the proposed management activities planned in the Salton Sea 10-Year Plan or the environmental assessment for the implementation of the 10-Year Plan's projects. No cumulative impacts would result as the Proposed Action is not adding additional impacts to those that are already occurring; however, these impacts might occur sooner under the Proposed Action.

Issue 4: How would management of water availability for the Lower Division States affect the landscape character?

Summary

The No Action Alternative would initially have lower impacts on the character of irrigated and agricultural landscapes within the Lower Division States, compared with the Proposed Action. If the elevation of Lake Mead continues to drop toward dead pool, under the No Action Alternative, dramatic decreases in water availability could occur; this would affect all three Lower Division States. Based on current lake level modeling, these reductions in water deliveries are not anticipated during the planning period. The Proposed Action establishes a series of water supply adjustments based on lowering elevations of Lake Mead and application of conservation measures to temper these effects. Potential water shortages would be allocated across all three Lower Division States, resulting in more widely distributed, but less intense, effects on the character of irrigated and agricultural landscapes in the Lower Division States compared with under the No Action Alternative.

Based on the expedited exposure of the Salton Sea lakebed under the Proposed Action, resulting in the diminishing influence of water on adjacent landscapes, greater indirect impacts on the landscape character adjacent to the Salton Sea during the planning period (through 2026) are anticipated compared with under the No Action Alternative. The long-term impacts would become the same between the No Action Alternative and Proposed Action as modeling predicts a similar amount of lakebed could be exposed through 2045 (Tetra Tech 2023).

No Action Alternative

Since the No Action Alternative includes minor adjustments to the distribution of water for Arizona and Nevada (no adjustments for California), based on lowering Lake Mead elevations, there would initially be a limited incremental effect on irrigated landscapes, including those in agricultural use. If elevations in Lake Mead were to drop to dead pool (895 feet), the 80 percent ESP analysis identifies

that lake levels would not approach this threshold during the planning period, and flows from Lake Mead would dramatically decrease. This would result in lower water deliveries than currently allocated, affecting all three Lower Division States.

Depending on the duration of these decreased water deliveries, the character of irrigated and agricultural landscapes within the Lower Division States would be modified through aridification of these areas; this would diminish the vivid greens associated with crops and ornamental plantings. The influence of the Colorado River into adjacent lands would narrow as these areas would transition to their natural, arid condition. This would result in large-scale changes to the landscape character compared with the existing condition. (For more information on the impacts on agricultural operations under the No Action Alternative, refer to **Section 3.16**, Socioeconomics).

Based on modeling identifying the extent of the Salton Sea lakebed that could be exposed through management of water use from the Colorado River, up to 35,594 acres of lakebed could be exposed through 2026 (Tetra Tech 2023). This additional exposure of the lakebed, and the reduced influence of water into adjacent landscapes, would lead to diminishing scenic quality within these landscapes over the long term with views of these changes occurring from the Salton Sea State Recreation Area, Salton Sea National Wildlife Refuge, multiple California state routes (State Routes 78, 86, and 111), and adjacent residential areas. No modifications to the Dos Palmas landscape, an area identified as possessing a high level of existing scenic quality, are anticipated under the No Action Alternative.

Proposed Action

The Proposed Action includes a series of water supply adjustments for the Lower Division States based on lower elevations of Lake Mead. If water levels in Lake Mead drop below 1,090 feet, similar effects as described under the No Action Alternative are anticipated, with proposed SEIS conservation measures tempering these effects. As lake levels continue to drop toward 1,025 feet, all three states would receive less water from the Colorado River under this alternative through proposed shortages and conservation measures.

As Lake Mead approaches dead pool, to avoid a dramatic decrease in water releases from Hoover Dam affecting all three Lower Division States, more reductions could occur. These include further reductions in water deliveries based on extraordinary circumstances, as described in Section 7(D) of the 2007 Interim Guidelines. These reductions to avoid reaching dead pool would temper the impacts on the character of irrigated and agricultural landscapes within the Lower Division States, as described under the No Action Alternative. Lower water releases would potentially lead to aridification of areas affected by water shortages, diminishing the vivid greens associated with crops and ornamental plantings; however, they would occur more gradually than under the No Action Alternative. The influence of the Colorado River into adjacent lands would begin to narrow in all three Lower Division States as these areas would transition to their natural, arid condition. This would result in large-scale changes to the landscape character compared with the existing condition. (For more information on the impacts on agricultural operations under the Proposed Action, refer to **Section 3.16**, Socioeconomics).

Based on modeling identifying the extent of the Salton Sea lakebed that could be exposed through management of water use from the Colorado River, including the application of drought-reduction

and conservation measures, up to 40,224 acres of lakebed could be exposed through 2026 (Tetra Tech 2023). This expedited exposure of the lakebed, and diminished influence of water into adjacent landscapes, would lead to the further reduction of scenic quality within these landscapes during the planning period (through 2026). Long-term impacts would become similar to those under the No Action Alternative as modeling predicts a similar amount of lakebed could be exposed through 2045 (Tetra Tech 2023). Views of these changes would occur from the Salton Sea State Recreation Area, Salton Sea National Wildlife Refuge, multiple California state routes (State Routes 78, 86, and 111), and adjacent residential areas. No modifications to the Dos Palmas landscape, an area identified as possessing a high level of existing scenic quality, are anticipated under the Proposed Action.

Cumulative Effects

The LTEMP SEIS includes two elements: smallmouth bass flow options and a potential adjustment to HFE sediment account periods and implementation windows. The smallmouth bass flow options would result in temporary changes to daily and hourly flows, which would not impact reservoir levels or water deliveries in the Lower Division States. The potential adjustment to HFE sediment accounting periods and implementation windows could result in changes in the timing of HFEs, which could minimally affect monthly reservoir levels in Lake Powell and Lake Mead. These differences are expected to be minor, temporary, and resolved by the end of the operational year; they would result in no changes to water deliveries in the Lower Division States. Therefore, no additive cumulative effects would occur on the landscape character in these areas, with the same effects described above occurring for each alternative.

Future increases in consumptive use of Colorado River water in the Upper Division States, intrastate water transfers in the Lower Division States (e.g., Quantification Settlement Agreement water transfers), implementation of the LCR MSCP, and various requirements and constraints applied to the operation of the Colorado River system were included in modeling of future system conditions.

The Salton Sea Management Program's 10-Year Plan identifies a series of aquatic habitat and dust suppression projects to improve conditions around the Salton Sea. The US Army Corps of Engineers recently completed an EA for the implementation of these projects, which would result in long-term beneficial impacts on the area's scenic quality under all action alternatives. Combined with either the No Action Alternative or the Proposed Action under this SEIS, the successful implementation of the 10-Year Plan's aquatic habitat and dust suppression projects could result in countervailing cumulative effects that partially temper the long-term impacts on scenic quality from additional exposure of the Salton Sea lakebed.

3.11 Cultural Resources

3.11.1 Affected Environment

For the cultural resources affected environment, the data and discussion are summarized from **Section 3.9**, Cultural Resources, of the 2007 FEIS. New information has been included when appropriate.

As defined in the 2007 FEIS, cultural resources "include historic and prehistoric buildings, structures, sites, and objects, including Indian sacred sites and traditional cultural properties." Historic properties are a subset of cultural resources (Reclamation 2007) that have special protections under the National Historic Preservation Act of 1966, as amended (NHPA). Per the implementing regulations of the NHPA, "historic properties" are districts, sites, buildings, structures, or objects listed on or eligible for listing on the National Register of Historic Places (NRHP); these include properties of traditional religious and cultural importance to an Indian Tribe or Native Hawaiian organization that meet the NRHP criteria (36 CFR 800.16(l)(1)).

The NPS manages GCNP, LMNRA, and GCNRA for recreation and resource protection. Reclamation manages water operations. The cultural resources in the portion of GCNRA below Glen Canyon Dam and the cultural resources in the Grand Canyon are protected under the GCPA. GCNP is also a designated United Nations Educational, Scientific, and Cultural Organization World Heritage Area.

Reclamation and the NPS have NHPA agreements for the management of historic properties under their care. For example, Lake Mead's General Management Plan Amendment/Low-Water Plan/EA of December 2018 anticipates NPS actions as the land manager and the need for resource protection at lake elevations above 950 feet. The plan states, "Archaeological and historical resources in the park have been adversely impacted from past development, vandalism, illegal activities, and natural processes. Lowering lake levels would continue to expose formerly submerged resources, which could result in adverse impacts from visitor use or vandalism. The NPS would continue to undertake measures to minimize or mitigate potential impacts through monitoring, educating the public, and restricting use in sensitive areas" (DOI 2018). LTEMP also includes a Reclamation programmatic agreement (PA) to mitigate the adverse effects on historic properties caused by dam operations.

Study Area and Area of Potential Effects

The 2007 Interim Guidelines were developed due to water shortages, "particularly under drought and low reservoir conditions" (Reclamation 2007). They identified the area of potential effects (APE) defined by Reclamation as the reaches of the Colorado River from Lake Powell to Imperial Dam. In the reach from Davis Dam to Imperial Dam, the APE consists of the Colorado River channel from bank to bank and the backwaters, lakes, and marshes connected to the river. This APE was used for the current NEPA analysis area and will be used in this document.

Identification Efforts

For the 2007 FEIS, Reclamation compiled all available previous research on cultural resources from the NPS and available literature. These data are summarized below. The NPS provided additional and more recent data (NPS 2023b). Because most resources of concern were submerged during the creation of the lakes, no new data on archaeological sites are needed for this analysis. Cultural resources found in the deepwater zone of reservoirs are the least vulnerable to effects from wave action and other disturbances. Those in the operational zones are vulnerable, and those above the pool elevation are at risk for damage and disturbance by visitation (Reclamation 2007). A recent study by the NPS at the GCNRA of sites at Lake Powell confirmed this conclusion (Burns et al. 2022).

Section 106 of the National Historic Preservation Act and Tribal Consultation

Per Section 106 of the NHPA and its implementing regulations (36 CFR 800), Reclamation consults with the Arizona, California, Colorado, Nevada, Utah, and Wyoming State Historic Preservation Offices (SHPOs); Tribal Historic Preservation Officers (THPOs); affected Tribes without THPOs; and consulting parties regarding the effects of the undertaking on historic properties and the resolution of adverse effects not covered under existing agreement documents. Per 36 CFR 800.6, adverse effects on historic properties not covered by existing agreement documents will be resolved by the appropriate land managing agency in consultation with the SHPOs, THPOs, Tribes, and consulting parties. Reclamation has also initiated consultation with concerned parties for the resolution of adverse effects due to this SEIS. A description of the Section 106 consultation to date, including a list of affected Tribes, can be found in **Chapter 4**, Consultation and Coordination.

Lake Powell and Glen Canyon Dam

Of the 518 historic properties recorded around Lake Powell during the Glen Canyon Project from 1956 and 1963 (prior to the inundation of Lake Powell), 447 sites were not subjected to excavation or testing (Reclamation 2007). In addition, resources of Tribal concern have been documented in the Lake Powell and Glen Canyon Dam area. The NPS reported that at least 234 known archaeological sites are inundated at Lake Powell, but this is likely an underestimation (Morgan and Conlin 2023).

Glen Canyon Dam to Lake Mead

This reach extends from the GCNRA into GCNP, the Navajo Indian Reservation, and the Hualapai Indian Reservation. The Havasupai, Hopi, Hualapai, North Kaibab Band of the Paiute, and Zuni Tribes all have strong cultural ties to the landscape and regard that reach as part of their traditional land.

A survey of this reach in the 1990s identified 336 sites that may be affected by the dam's operations; 313 were determined eligible for listing on the NRHP, 14 were determined ineligible, and 9 were unevaluated for listing on the NRHP. More recently within Glen Canyon, 53 archaeological sites have been identified within the GCNRA and the Navajo Nation along this reach; none of these 53 sites have had formal determinations of eligibility completed, and all are currently treated as eligible sites (NPS 2023c). For LTEMP, the analysis covered 366 sites in the Grand Canyon National Park (NPS 2023c).

As discussed in Section 3.8 of the LTEMP FEIS, research has shown that sediment within the active river channel and/or deposited by HFEs can be transported by the wind to terraces bordering aeolian deposits that contain historic properties (East et al. 2016; Hazel et al. 2022). Wind-deposited sediment can help stabilize and preserve the archaeological properties in place at an average rate of a few millimeters a year (East et al. 2016; Sankey et al. 2023a; Sankey et al. 2023b). Some HFEs could benefit sediment deposition to keep covered archaeological resources that would otherwise be exposed through erosion. Current dam operations and the absence of annual HFEs have the potential to impact in situ preservation using this method of aggregate sediment cover.

Lake Mead to Hoover Dam

Nearly 1,500 prehistoric and historic-aged resources have been documented in this reach; three of these (Hoover Dam, Lost City/Pueblo Grande de Nevada, and B-29 Heavy Bomber) are listed on

the NRHP (Reclamation 2007). Hoover Dam is also a National Historic Landmark. Due to the advanced age of the reservoir, no comprehensive cultural surveys were conducted prior to inundation. Early surveys and site documentation focused on large, salient resources. Many documented sites have not yet been evaluated for inclusion on the NRHP. When water in Lake Mead rose in elevation from 1,083 feet to 1,102 feet in 1937, many of these resources were submerged.

Fluctuations in the water level from 1,083 to 1,226 feet have resulted in the repeated exposure of resources and wave action in that zone, which has adversely affected the resources' integrity (Reclamation 2007). However, submerged resources are likely to still maintain integrity for listing on the NRHP. Over 100 resources have been recorded in the Lake Mead operational zone (1,083–1,226 feet); some resources have been damaged or destroyed, while others retain a moderate to high level of integrity (NPS 2023b). Over 50 resources are below 1,083 feet and may retain integrity (NPS 2023b). Sonar scans indicated that thick sediments may be protecting some resources (Reclamation 2007).

Lake Mohave and Davis Dam

Previous surveys identified 89 sites within or adjacent to Lake Mohave and Davis Dam (Reclamation 2007). Resources between 628 and 647 feet have been subjected to wave action and likely have lost integrity; sites below 628 feet may still retain greater integrity than those between 628 and 647 feet. An NRHP-listed traditional cultural property (TCP) important to several Tribes is found within this reach.

Davis Dam to Parker Dam

This portion of the system is split into the river reach from Davis Dam to Upper Lake Havasu and the reach of Lake Havasu and Parker Dam.

Davis Dam to Upper Lake Havasu

Prehistoric and historic resources have been documented within this reach; however, many of them have been significantly impacted by development, flood events, and alterations to the reach during the 1950s (Reclamation 2007).

Lake Havasu and Parker Dam

Eight historic cultural resources have been documented beneath Lake Havasu, and 20 prehistoric sites have been documented at the edge of the lake or on islands or peninsulas in the lake (Reclamation 2007). Several historic Chemehuevi Indian villages are known to have been located along the river in the Chemehuevi Valley. Resources within the lake's current or historical operational zone (ranging from 450.5 to 445.8 feet) will have been affected by the rising and falling water levels. Resources that have remained submerged are likely to have been protected (Reclamation 2007).

Parker Dam to Imperial Dam

Three individual resources have been recorded within the analysis area/APE; these are Parker Dam, Imperial Dam, and the Old Parker Road alignment. One historic district, the Parker Dam Historic District, extends into the analysis area/APE (Reclamation 2007).

Imperial Dam to SIB

Two resources within the reach are listed on the NRHP: the Ocean-to-Ocean Bridge and the Yuma Crossing and Associated Sites National Historic Landmark (Reclamation 2007).

Salton Sea

Information provided in the records search and pedestrian survey of dust suppression opportunity areas found in the Salton Sea Management Program's Phase 1: 10-Year Plan EA (US Army Corps of Engineers 2022) can be used to demonstrate possible resource types to be found along the shore of the Salton Sea. The records search resulted in six previously conducted surveys and two previously recorded sites. The dust suppression opportunity area survey covered 2,000 acres and concluded that (1) some of the opportunity areas are un-surveyed, (2) those areas that are surveyed lack prehistoric sites and have a few ineligible historic-age sites connected to recreation, and (3) the resource potential of the dry lakebed is unknown because no subsurface investigations have been done (US Army Corps of Engineers 2022).

Ethnographic Resources and Traditional Cultural Properties

From time immemorial, the Colorado River and its canyons have been sacred places for Native communities. The Colorado River features prominently in the cosmology and culture of Indigenous peoples of the Southwest (Reclamation 2016). For the Tribes, the Colorado River and its canyons are living, sentient entities consisting of sacred spaces, the homes of their ancestors, the residence of the spirits of their dead, and the source of culturally important resources. Many Tribes see themselves as stewards of the Colorado River and its canyons, which are a vital part of the living world; caring for the river and the canyons is their responsibility.

The river and canyons are considered by many Indigenous groups to be a type of historic property known as a TCP. Per *National Register Bulletin* 38, a TCP is a historic property that is eligible for the NRHP for "its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community" (Parker and King 1990). Of the groups concerned, the Hualapai Tribe (Coulam 2011), Hopi Tribe (Hopi CPO 2001), Navajo Nation (Maldonado 2011), and Pueblo of Zuni (Dongoske 2011) have prepared NRHP nomination forms for the Colorado River and its canyons as a TCP. In addition, consultation with the Tribes is ongoing at this time and any additional information, including Traditional Ecological Knowledge, will be incorporated as it becomes available.

3.11.2 Environmental Consequences

Methodology

In the 2007 FEIS, the 10th percentile as the "worst-case scenario" for Lake Powell was used for each alternative to assess the impacts of lake elevation on cultural resources. Based on this, the lowest Lake Powell water elevation accounted for was 3,496 feet. Anticipated lake elevations below 3,496 feet will be addressed in the current analysis. For Lake Mead, an elevation of 1,080 feet was used as the lowest elevation in the 2007 FEIS. In the current analysis, elevations below 1,080 feet will be assessed also using the 10th percentile as the worst-case scenario. For resources along the river, the 2007 FEIS states that "[P]rocesses that might result in a loss of integrity vary by reach and

property type; consequently, methods of assessing effects differ by reach" (Reclamation 2007). However, most impacts within the reaches were assessed by comparing anticipated flows between alternatives.

The USGS has conducted a study of the availability of windblown sediment in the reach between Glen Canyon Dam and Bright Angel Creek (Kasprak et al. 2023). Windblown (or aeolian) sediment can be important for the protection of archaeological sites from erosion. Dry sediment is transported by the wind from the riverbed to archaeological sites along the river where the sediment covers and protects the sites. Currently, Reclamation conducts HFEs from Glen Canyon Dam to replace sediment along beaches and sandbars along the reach. The results of this study are discussed below.

The NPS has provided some initial considerations about the effects of inundation and fluctuating water levels at Lake Powell (Morgan and Conlin 2023). In general, fluctuating water levels at the lake create an environment where resources are more vulnerable to wave impacts, wet-dry cycling, and erosion, as well as changes in water chemistry, pH, and salinity which may affect preservation. Inundation of resources, while making them inaccessible, may provide a better environment for preservation than inundation coupled with subsequent exposure.

Adverse effects on historic properties will be resolved by the appropriate land management agency based on existing mitigation documents and through the consultation process under development for this SEIS (36 CFR 800).

Impacts Analysis Area

The impacts analysis area for cultural resources is consistent with that used in the 2007 FEIS. It consists of the reaches of the Colorado River from Lake Powell to Imperial Dam and the reach from Davis Dam to Imperial Dam. The APE consists of the Colorado River channel from bank to bank and the backwaters, lakes, and marshes connected to the river.

Assumptions

The assumptions for the following analysis are:

- Archaeological site data, as discussed in the 2007 FEIS and without specific locations, were used.
- Impacts on cultural resources can be characterized based on projected lake elevations and river flows by describing expected impacts in zones exposed or inundated.

Impact Indicators

Impact indicators for this analysis are:

- Projected lake elevations that fall below levels previously analyzed in the 2007 FEIS that may expose historic properties to damage from wave action, wet/dry cycling, or increased visitation

- Projected changes in river flows that are not addressed within LTEMP that may contribute to erosion and exposure of resources that may expose historic properties to damage from erosion, wet/dry cycling, or increased visitation
- Availability of windblown sediments to protect archaeological sites
- Negative effects on TCPs that were not discussed in the 2007 FEIS or LTEMP FEIS
- Changes in access to sacred sites

Issue 1: How would changes in lake elevations from water releases from Lake Mead and from equalizing and balancing Lake Mead and Lake Powell affect previously submerged archaeological sites, as well as those at the lake margins?

Summary

Both alternatives would result in lake elevations that may further expose resources to damage from wave action, wet/dry cycling of fluctuating water levels, increased visitation, and unauthorized collection or vandalism at Lake Mead but not at Lake Powell. Lake Powell's elevation is expected to remain above 3,500 feet. This would protect those cultural resources below that level. For Lake Mead, the Proposed Alternative would have fewer negative impacts on cultural resources than the No Action Alternative because pool elevations would be slightly higher. Resources at the lake margins would still be vulnerable to wave action and wet/dry cycling, and resources above the lake elevation could be subjected to more visitation. Adverse effects on historic properties would be resolved through the consultation process for this SEIS, which is currently under development.

No Action Alternative

Under the No Action Alternative, Lake Powell's projected pool elevation for the 10th percentile through 2024 is approximately 3,550 feet. In 2025 through 2026, pool elevations for the 10th percentile are projected to dip as low as 3,500 feet. The lake pool elevation will not dip to or below minimum power pool. Resources below 3,496 feet are not expected to be exposed.

Lake Mead pool elevations are occasionally below 1,080 feet and, for the 10th percentile, are projected to dip to approximately 1,040 feet by the end of 2024. Between 2025 and 2026, the 10th-percentile scenario is for the pool elevation at Lake Mead to dip almost to 1,000 feet. The lake pool elevation will not dip to or below minimum power pool. Known resources between 1,000 and 1,080 feet are primarily prehistoric sites recorded prior to the inundation of the lake; these could be exposed for an extended period. These sites could be affected by wave action at the lake margins and wet/dry cycles. They also could experience increased visitation from hikers.

Proposed Action

Under the Proposed Action, Lake Powell's projected pool elevations are expected to be the same as under the No Action Alternative. Lake Mead's pool elevation would remain around 1,050 feet through 2024 and then would dip to approximately 1,025 feet. Resources between 1,025 and 1,080 feet would be exposed for an extended period and could be affected by wave action, wet/dry cycles, and increased visitation.

Cumulative Effects

One reasonably foreseeable future project that may, in conjunction with the proposed near-term Colorado River operations, contribute to cumulative effects on cultural resources is the LTEMP SEIS. Reclamation is analyzing flow options to prevent smallmouth bass from establishing below Glen Canyon Dam and will analyze new information regarding the sediment accounting window associated with the HFE protocol. All proposed flow adjustments analyzed in the LTEMP SEIS will adhere to operational and regulatory constraints for lake elevations as outlined in LTEMP.

The smallmouth bass flow options would result in temporary changes to daily and hourly flows, which would not impact long-term reservoir levels. Therefore, the potential change of smallmouth bass flow options would result in no changes to annual or monthly reservoir levels in Lake Powell or Lake Mead. The potential adjustment to HFE sediment accounting periods and implementation windows could result in changes in the timing of HFEs, which could minimally affect monthly reservoir levels in Lake Powell and Lake Mead. These differences are expected to be minor, temporary, and resolved by the end of the operational year; they would result in no changes to annual reservoir levels in Lake Powell or Lake Mead.

Reclamation is consulting with stakeholders regarding any potential adverse effects under Section 106 of the NHPA. If Reclamation determines there is an adverse effect on a historic property or its contributing elements, the effect will be resolved under the LTEMP PA and the Nonnative Fish MOA. If potential adverse effects can be resolved, the project should not contribute to cumulative impacts in conjunction with the proposed near-term Colorado River **o**perations.

No cumulative effects would occur on previously submerged archaeological sites from the proposed management activities planned in the Salton Sea 10-Year Plan or the environmental assessment for the implementation of the 10-Year Plan's projects. No cumulative impacts would result as the Proposed Action is not adding additional impacts to those that are already occurring; however, these impacts might occur sooner under the Proposed Action.

Issue 2: How would changes in river flows from water releases from Lake Mead and from equalizing and balancing Lake Mead and Lake Powell affect archaeological sites along the river and the Salton Sea?

Summary

For both alternatives, water releases will be within those defined for LTEMP. Reclamation does not anticipate any additional impacts on archaeological sites other than those analyzed under LTEMP. No additional impacts on resources at the Salton Sea would occur under either alternative. Adverse effects on historic properties would be resolved through the LTEMP PA or land management agency NHPA agreements. Any additional adverse effects on historic properties not covered under existing agreements will be resolved through the consultation process for this SEIS.

No Action Alternative

Under the No Action Alternative, releases from Glen Canyon Dam would be within the range of LTEMP releases, and river water levels would be consistent with LTEMP. Reclamation would not anticipate additional impacts on archaeological resources other than those analyzed under LTEMP.

Under the No Action Alternative, exposed, dry sand available for windblown transport would range from a mean of 1,489,311 square meters (m^2) at the 100th percentile to 1,572,250 m^2 at the 80th percentile (Kasprak et al. 2023). However, under the No Action Alternative, HFEs to replenish beach and sandbar sediment would occur as defined under LTEMP (Salter and Grams 2023). The HFEs would allow more sediment to be available for windblown transport to cover archaeological sites with protective sediment.

Flows into the Salton Sea from the Imperial Irrigation District and Coachella Valley Water District would continue at levels similar to today; no changes to impacts on cultural resources from those analyzed in the Salton Sea Management Program's Phase 1: 10-Year Plan EA (US Army Corps of Engineers 2022) are expected. Exposed resources may be subjected to increased wave action, wet/dry cycling, and visitation. However, the lack of previously recorded NRHP-eligible historic properties along the current shoreline likely means the risk of exposing significant cultural resources is low.

Proposed Action

Under the Proposed Action, releases from Glen Canyon Dam would be within those defined by LTEMP. If releases need to be reduced to protect the 3,500-foot level due to low water levels in Lake Powell, releases would be at least the minimum under LTEMP. Like under the No Action Alternative, no additional impacts from low river water levels are anticipated under the Proposed Action.

Available sediment for wind-borne transport would be about the same as under the No Action Alternative. Also, under the Proposed Action, the likelihood that HFE releases to restore sediment would occur is essentially the same as under the No Action Alternative.

Under the Proposed Action, if conservation measures are required and implemented, less water would flow into the Salton Sea, which may lead to the exposure of cultural resources in the lakebed more quickly than under the No Action; however, exposed cultural resources would eventually be the same as under the No Action Alternative.

Cumulative Effects

One reasonably foreseeable future project that may, in conjunction with the proposed near-term Colorado River operations, contribute to cumulative effects on cultural resources is the LTEMP SEIS. Reclamation is analyzing flow options to prevent smallmouth bass from establishing below Glen Canyon Dam and will analyze new information regarding the sediment accounting window associated with the HFE protocol. All proposed flow adjustments analyzed in the LTEMP SEIS will adhere to operational and regulatory constraints for lake elevations as outlined in LTEMP. The smallmouth bass flow options would result in temporary changes to daily and hourly flows, which would not impact river levels. The potential adjustment to HFE sediment accounting periods and implementation windows could result in changes in the timing of HFEs, which could minimally affect river levels.

Reclamation is consulting with stakeholders regarding any potential adverse effects under Section 106 of the NHPA. If Reclamation determines there is an adverse effect on a historic property or its

contributing elements, the effect will be resolved under the LTEMP PA and the Nonnative Fish MOA. If potential adverse effects can be resolved, the project should not contribute to cumulative impacts in conjunction with the proposed near-term Colorado River **o**perations.

For the Salton Sea, the Salton Sea 10-Year Plan, as analyzed in the Salton Sea Management Program's Phase 1: 10-Year Plan EA (US Army Corps of Engineers 2022) may also, in conjunction with the proposed near-term Colorado River operations, contribute to cumulative effects on cultural resources. Because of gaps in survey and resource evaluation, it is unknown the extent that management activities described within the 10-Year Plan may impact historic properties; however, a PA has been developed to provide procedures for identifying and evaluating historic properties, as well as measures to resolve adverse effects on historic properties. If potential adverse effects can be resolved, the project should not contribute to cumulative impacts in conjunction with the proposed near-term Colorado River **o**perations.

Issue 3: How would changes in operations affect TCPs and resources of concern to Native Americans?

Summary

Impacts on TCPs and resources of concern to Native Americans would be the same under both alternatives and would consist primarily of lower water levels at Lake Mead, which may expose sacred sites to visitors. Any adverse effects on TCPs would be resolved through the LTEMP PA or through the consultation process for this SEIS.

No Action Alternative

Under the No Action Alternative, the water level at Lake Powell is not expected to drop below 3,500 feet, which is above the 3,496 feet analyzed under the 2007 Interim Guidelines. No additional impacts on resources at Lake Powell are expected. At Lake Mead, sacred sites could be more accessible to visitors above 1,040 feet in 2024 and above 1,025 feet in 2025 and 2026. Because releases from Lake Powell will be within those defined by LTEMP, no additional impacts on resources along the river are expected. There would be little change of habitat for native riparian plant species (Butterfield and Palmquist 2023c). No significant adverse effects would occur on fish that are a contributing element to the Colorado River TCP and to the health of the ecosystem as a whole.

Proposed Action

Impacts on TCPs and resources of concern to Native Americans would be the same for the Proposed Action as the No Action Alternative.

Cumulative Effects

One reasonably foreseeable future project that may, in conjunction with the proposed near-term Colorado River operations, contribute to cumulative effects on TCPs is the LTEMP SEIS. Reclamation is analyzing flow options to prevent smallmouth bass from establishing below Glen Canyon Dam and will analyze new information regarding the sediment accounting window associated with the protocol. All proposed flow adjustments analyzed in the LTEMP SEIS will adhere to operational and regulatory constraints for lake elevations as outlined in LTEMP. The smallmouth bass flow options would result in temporary changes to daily and hourly flows, which

would not impact long-term reservoir levels. Therefore, the potential change of smallmouth bass flow options would result in no changes to annual or monthly reservoir levels in Lake Powell or Lake Mead.

The potential adjustment to HFE sediment accounting periods and implementation windows could result in changes in the timing of HFEs, which could minimally affect monthly reservoir levels in Lake Powell and Lake Mead. These differences are expected to be minor, temporary, and resolved by the end of the operational year; they would result in no changes to annual reservoir levels in Lake Powell or Lake Mead.

Reclamation is consulting with stakeholders regarding any potential adverse effects under Section 106 of the NHPA. If Reclamation determines there is an adverse effect on a TCP, the effect will be resolved under the LTEMP PA, the consultation process for this SEIS, and/or Section 106; therefore, the project should not contribute to cumulative impacts in conjunction with the proposed near-term Colorado River operations.

No cumulative effects would occur on TCPs and resources of concern to Native Americans from the proposed management activities planned in the Salton Sea 10-Year Plan or the environmental assessment for the implementation of the 10-Year Plan's projects. No cumulative impacts would result as the Proposed Action is not adding additional impacts to those that are already occurring; however, these impacts might occur sooner under the Proposed Action.

3.12 Paleontological Resources

3.12.1 Affected Environment

Paleontological resources include (with some exceptions) any fossilized remains, traces, or imprints of organisms preserved in or on the earth's crust. The Paleontological Resources Preservation Act of 2009 (PRPA; 16 United States Code [USC] 470aaa–470aaa-11) and its implementation rule (43 CFR 49) require that the Department agencies preserve, manage, and protect paleontological resources on lands administered by the BLM, Reclamation, the NPS, and the Service and ensure these federally owned resources are available for current and future generations to enjoy and study as part of America's national heritage.

The 2007 FEIS (Reclamation 2007) and the 2017 LTEMP FEIS do not address paleontological resources as a separate resource concern; however, many of the potential impact issues related to reservoir levels and changes in river flows are analogous to those for cultural resources, such as archaeological sites.

The NPS is primarily responsible for conservation of natural and cultural resources and the visitor experience, including recreation, at Lake Mead and Lake Powell. Reclamation manages water operations. Both agencies comply with the PRPA. For example, Lake Mead's General Management Plan Amendment/Low-Water Plan/EA of December 2018 anticipates NPS actions and resource protection at lake elevations above 950 feet.

Study Area

In this region, the fossil record near the Colorado River can be traced back to 1.2 billion years ago. The thick sequence of overlying Paleozoic sedimentary strata preserve abundant fossil remains and traces of marine and terrestrial invertebrates, vertebrates, and plants. An extensive cave system developed into marine limestones preserves the remains of a diverse Pleistocene fauna (Santucci and Tweet 2021).

The study area for paleontological resources consists of the reaches of the Colorado River from Lake Powell to Imperial Dam and the reach from Davis Dam to Imperial Dam. It includes the Colorado River channel from bank to bank and the backwaters, lakes, and marshes connected to the river. Special attention is paid to known and unknown resources in Lake Powell and Lake Mead. It is anticipated that most potential resources and localities were submerged during the filling of the reservoirs. There are minimal data developed on potential paleontological resources in the deepwater zone of the reservoirs, but these resources may be the least vulnerable to effects from wave action and other disturbances. Resources in the operational zones are vulnerable, and those above the fluctuating pool elevation are at risk for damage and disturbance by visitation.

Lake Powell and Glen Canyon Dam

Lake Powell is 186 miles long and contains 1,960 miles of shoreline, which includes 96 major side canyons. The landscape includes over 10,000 vertical feet of sedimentary rocks that represent approximately 300 million years of earth's history. This geologic history includes several mountain-building events, the formation of the supercontinent Pangea, multiple incursions of shallow seas onto the North American continent, vast deserts with Sahara-like sand dunes, the rise and demise of the dinosaurs, unique igneous intrusions known as laccoliths, and the carving of the Colorado River system. Features in the sedimentary rock strata document marine, nearshore marine, fluvial, and eolian environments that have transformed the landscape of southeastern Utah through geologic time.

Current available GIS data for known paleontological sites are approximate locations and come from a variety of data sets and reports of varying quality and accuracy. NPS staff from the GCNRA, Intermountain Region, and Washington Office are working on a 2-year project to compile and update existing data into one authoritative source. Initial work on this project suggests the current understandings of the resources are limited. Actual distribution and the significance of resources are likely underrepresented in current data, yielding insufficient insight into potential impacts. The current database lacks information pertaining to several surveys prior to the 1990s and designations of scientific significance for each locality, despite several holotypes originating from the area.

These deficiencies aside, based on current best available GIS paleontological data, at approximately 3,522 feet (the current elevation as of February 16, 2023), 39.68 percent of known paleontological sites are inundated. Specific studies of the effects of inundation on paleontological locations are not known from Lake Powell. Anecdotal evidence from staff working in the field has resulted in documentation of sandstone becoming friable and crumbly after previous inundation and exposure. It is assumed that certain kinds of paleontological resources, especially trackways, found in softer bedrock, such as sandstone, would be destroyed or severely impacted by the inundation and subsequent exposure, resulting in the loss of rock outcrop integrity.

However, it is not known whether greater damage is caused only by inundation, or by repeated cycles of inundation and exposure. It is assumed that paleontological resources, including both fossils and trackways, would have similar impacts as those in archaeological sites from similar processes. The No Action Alternative would result in greater exposure of bedrock outcrops and greater exposure of previously inundated paleontological sites to wet/dry cycling; thus, it has the potential to result in greater numbers of paleontological sites being subject to exposure-related erosion and damage.

Erosion is the primary agent that exposes paleontological resources on the surface. Reclamation manages a significant amount of land along the Colorado River corridor. The effects of fluctuating water levels and wave action resulting in higher-than-normal erosional rates and an increased potential for the exposure of paleontological resources. From a scientific perspective, elevated erosion levels along waterways provide an opportunity because fossil resources may be exposed more quickly, allowing for more frequent discoveries. Yet from a management perspective, these elevated erosion levels present the concern for elevated levels of loss potential (Bonde and Slaughter 2020). During a survey conducted in March of 2023, a known dinosaur trackway on a ledge experienced increased rates of undercutting, leading to resource loss as it breaks away.

The GCNRA has one of the most extensive exposures of rocks from the Mesozoic era of any NPS unit, providing exceptional documentation of ecosystems and paleoclimates from approximately 252 million to 66 million years ago. Marine fossils are common in Paleozoic limestones, while dinosaur tracks are found in the terrestrial Mesozoic units. Pollen extracted from dung and packrat middens has provided evidence for the ecology and climate during the more recent Quaternary period. The NPS maintains an inventory and monitoring database for known fossil sites in the GCNRA. Natural degradation and fossil theft remain a concern for resource managers.

Because of Glen Canyon Dam, sediment is continuously deposited in Lake Powell. Sediment deposition has impacted several locations in the lake, including paleontological sites. Sediment deposition may prevent exposure of paleontological resources (Graham 2016).

Lake Mead and Hoover Dam

The LMNRA does not have a comprehensive paleontological inventory of locations, but there are known and likely many unknown submerged paleontological resources. There are fossil sites that are exposed at recent lake levels and are subject to disturbance from fluctuating water levels and visitor impacts. Lake Mead has formations with high fossil potential, including the Miocene Horse Spring Formation, Muddy Creek Formation, and Pliocene and Pleistocene river gravels. Where these formations outcrop along the lake, they are now more spatially exposed, providing a high chance to find new fossil localities with them. Increased exposure of fossil-bearing geologic formations around the lake would be anticipated with lower lake levels and exposed shorelines.[19]

Salton Sea

The Salton Sea is situated in the Salton Trough, a major topographic depression extending north from the Sea of Cortez. Over the past 7 million years, a relatively complete geologic record of fossil-

[19] Chris Nycz, Cultural Resource Manager, LMNRA, email to Kevin Doyle, EMPSi resource lead, on February 17, 2023, regarding paleontological resources at LMNRA.

bearing sediment has been deposited. Paleontological remains are widespread and very diverse. Fossils range from both large and small marine organisms from when the ancestral Gulf of California filled the sea to later periods when sediments isolated the prehistoric Lake Cahuilla from the ocean. This playa lake, the precursor of the Salton Sea, was intermittently fed by the Colorado River, and it supported a wide variety of plants and animals. There is the potential for paleontological resources to be present within the playa margins.

Methodology

There was no formal analysis of effects on paleontological resources in the 2007 FEIS. Methods to qualitatively assess the potential for effects on paleontological resources use a proxy based on lake elevations developed for analyzing the potential for impacts on cultural resources. For cultural resources in the 2007 FEIS, Reclamation used the 10th percentile as the "worst-case scenario" for Lake Powell to assess the impacts for each alternative (Reclamation 2007). Similar to the cultural resource analysis in this SEIS, the lowest Lake Powell water elevation accounted for was 3,496 feet. The effects of anticipated lake elevations below 3,496 feet are addressed in this current analysis.

For Lake Mead, an elevation of 1,080 feet was used as the lowest elevation (Reclamation 2007). In this analysis, elevations below 1,080 feet will be assessed also using the 10th percentile as the "worst-case scenario." For resources along the river, the potential for impacts within the river reaches were assessed by comparing anticipated flows with the historical minimum and maximum river flows.

The USGS has conducted a study of the availability of windblown sediment by alternative in the reach between Glen Canyon Dam and Bright Angel Creek (Kasprak et al. 2023). Windblown (or aeolian) sediment can be important for assessing the potential exposure of paleontological resources. Dry sediment is transported by the wind from the riverbed to locations where paleontological resources may occur along the river and where the sediment covers and protects the sites. The results of this study are discussed below.

Impact Analysis Area

The impact analysis area for paleontological resources consists of the reaches of the Colorado River from Lake Powell to Imperial Dam and the reach from Davis Dam to Imperial Dam. It includes the Colorado River channel from bank to bank and the backwaters, lakes, and marshes connected to the river.

Assumptions

The assumptions for the following analysis are:

- Impacts on paleontological resources can be characterized based on projected lake elevations and river flows.
- The impact analysis area includes known paleontological resources that are being exposed and rock units that are sensitive for the presence of scientifically important paleontological resources.
- Specific paleontological locations are not discussed in this analysis, but the level of information available is assumed to be sufficient for this broad-based analysis.

- The exposure of paleontological resources may lead to the discovery of scientifically important fossils; however, the process and practical means of recovering paleontological resources within the reservoirs or associated with the Colorado River channel would be limited.
- Landforms with a higher degree of slope experience increased impacts from wave action erosion compared with low-slope areas.

Impact Indicators

Impact indicators for this analysis are:

- Projected lower lake elevations that may expose resources to damage from wave action, wet/dry cycling of fluctuating water levels, increased visitation, and unauthorized collection or vandalism
- Projected changes in river flows that are not within the historical minimum and maximum that may contribute to erosion
- Availability of windblown sediments to protect paleontological localities or exposed fossils

Issue 1: How would changes in lake elevations from water releases from Lake Mead and from equalizing and balancing Lake Mead and Lake Powell affect previously submerged paleontological resources, as well as those at the lake margins?

Summary

Both alternatives would result in lake elevations that may further expose resources to damage from wave action, wet/dry cycling of fluctuating water levels, increased visitation, and unauthorized collection or vandalism. Because Lake Powell's elevation is expected to remain above 3,500 feet, there would be less risk of negative impacts on paleontological resources below that level. For Lake Mead, any paleontological resources at the lake margins would be vulnerable to wave action and wet/dry cycling. Exposed fossils above the lake elevation may be subject to more visitation and possible damage or unauthorized collection. Pool elevations at Lake Mead would be slightly higher under the Proposed Action, and there would be less potential for negative impacts when compared with the No Action Alternative. Implementation of the PRPA by both the NPS and Reclamation would continue to provide protections and fines for disturbances to paleontological resources.

No Action Alternative

Under the No Action Alternative, Lake Powell pool elevations for the 10th percentile through 2024 are approximately 3,550 feet. In 2025 through 2026, pool elevations may dip to 3,500 feet; however, they would not dip below the minimum power pool, and additional paleontological resources would not be exposed.

Lake Mead pool elevations are occasionally below 1,080 feet; under the 10th percentile scenario, they are projected to dip to approximately 1,040 feet by the end of 2024. The 10th percentile scenario for Lake Mead between 2025 and 2026 is a pool level of almost 1,000 feet, potentially exposing paleontological resources. The elevation would not dip below the minimum power pool. Exposed fossil locations may be affected by wave action at lake margins, wet/dry cycles, and likely increased visitation.

Proposed Action

Under the Proposed Action, Lake Powell pool elevations are anticipated to be the same as under the No Action Alternative. Lake Mead pool elevations are projected to remain around 1,050 feet through 2024 and then drop to 1,025 feet during 2025 and 2026. The elevation would not dip below the minimum power pool. Fossils that may be present between 1,025 and 1,080 feet would be exposed and subject to potential impacts from wave action at lake margins, wet/dry cycles, and likely increased visitation.

Cumulative Effects

A reasonably foreseeable future project that may, in conjunction with the proposed near-term Colorado River operations, contribute to cumulative effects on paleontological resources is the LTEMP SEIS. Reclamation is analyzing flow options to prevent smallmouth bass from establishing below Glen Canyon Dam and will analyze new information regarding the sediment accounting window associated with the HFE protocol. All proposed flow adjustments analyzed in the LTEMP SEIS will adhere to operational and regulatory constraints for lake elevations as outlined in LTEMP.

The smallmouth bass flow options would result in temporary changes to daily and hourly flows, which would not impact reservoir levels. Therefore, the potential change of smallmouth bass flow options would result in no changes to annual or monthly reservoir levels in Lake Powell or Lake Mead. The potential adjustment to HFE sediment accounting periods and implementation windows could result in changes in the timing of HFEs, which could minimally affect monthly reservoir levels in Lake Powell and Lake Mead. These differences are expected to be minor, temporary, and resolved by the end of the operational year; they would result in no changes to annual reservoir levels in Lake Powell or Lake Mead. The project should not contribute to cumulative impacts in conjunction with the proposed near-term Colorado River **o**perations.

No cumulative effects would occur on previously submerged paleontological resources from the proposed management activities planned in the Salton Sea 10-Year Plan or the environmental assessment for the implementation of the 10-Year Plan's projects. No cumulative impacts would result as the Proposed Action is not adding additional impacts to those that are already occurring; however, these impacts might occur sooner under the Proposed Action.

Issue 2: How would changes in river flow from Lake Mead water releases and from equalizing and balancing Lake Mead and Lake Powell affect paleontological resources along the river and the Salton Sea shore?

Summary

Both alternatives would result in releases within those defined for LTEMP and would fluctuate river levels, lead to changes in river channel, and possibly expose paleontological resources to some impacts. No additional impacts on resources at the Salton Sea would occur under either alternative. However, the Proposed Action would more evenly distribute flows and reduce the potential for impacts on paleontological resources from fluctuating river levels. Sediment would be available for longer amounts of time and at more regular intervals than under the No Action Alternative.

No Action Alternative

Under the No Action Alternative, releases from Glen Canyon Dam would be within the range of LTEMP releases, and water levels would be consistent with LTEMP. Impacts on paleontological resources may occur from changes in erosion or depositional processes between Lake Powell and Lake Mead.

Under the No Action Alternative, the median acreages of available sediment for windblown transport would range from 1,489,311 m^2 at the 100th percentile to 1,572,186 m^2 at the 80th percentile (Kasprak et al. 2023). Increases in available sediment are a beneficial impact of low river flows because the sediment reduces the potential exposures of paleontological resources.

If reduced releases result in a low river level, they may increase visitor access to previously inundated and/or buried paleontological resources between Lake Powell and Lake Mead. For locations with increased access, there may be new deterioration of paleontological resources because of increased visitation. While lower river levels could give access to new paleontology sites, they could also restrict access to older ones that are no longer eye level or that have increased difficulty to reach due to an elevation gain or terrain (cliffs) acting as a barrier.

Flows into the Salton Sea from the Imperial Irrigation District and Coachella Valley Water District would continue at levels similar to today's levels; no changes to impacts on paleontological resources are expected, other than those analyzed in the Salton Sea Management Program's Phase 1: 10-Year Plan EA (US Army Corps of Engineers 2022). These impacts would include damage during construction and erosion of paleontologically sensitive sediment, which could unearth and disperse fossils. Exposed resources may be subject to increased wave action, wet/dry cycling, and visitation.

Proposed Action

Under the Proposed Action, releases from Lake Powell would be consistent with those approved and analyzed under LTEMP, while conditions permit. If insufficient water is available, releases would be coordinated to protect the minimum power pool elevation of 3,500 feet in Lake Powell.

As with the No Action Alternative, lower river levels due to changes in release volumes may also increase access to paleontological resources between Lake Powell and Lake Mead. For locations with increased access, there may be new deterioration of paleontological resources because of increased visitation. While lower river levels would give access to new paleontological sites, they could also restrict access to older ones that are no longer eye level or that have increased difficulty to reach due to an elevation gain or terrain (cliffs) acting as a barrier.

Under the Proposed Action, if conservation measures are required and implemented, less water would flow into the Salton Sea. This may lead to the exposure of paleontological resources in the lakebed more quickly than under the No Action; however, exposure would eventually be the same as under the No Action Alternative. Exposed resources may be subjected to increased wave action, wet/dry cycling, and visitation.

Cumulative Effects

One reasonably foreseeable future project that may, in conjunction with the proposed near-term Colorado River operations, contribute to cumulative effects on paleontological resources is the

LTEMP SEIS. Reclamation is analyzing flow options to prevent smallmouth bass from establishing below Glen Canyon Dam and will analyze new information regarding the sediment accounting window associated with the HFE protocol. All proposed flow adjustments analyzed in the LTEMP SEIS will adhere to operational and regulatory constraints for lake elevations as outlined in LTEMP. The smallmouth bass flow options would result in temporary changes to daily and hourly flows, which would not impact river levels.

The potential adjustment to HFE sediment accounting periods and implementation windows could result in changes in the timing of HFEs, which could minimally affect river levels. The proposed releases are within the previously approved flows and are unlikely to cause any additional impacts on paleontological resources. The project should not contribute to cumulative impacts in conjunction with the proposed near-term Colorado River operations.

For the Salton Sea, the Salton Sea 10-Year Plan, as analyzed in the Salton Sea Management Program's Phase 1: 10-Year Plan EA (US Army Corps of Engineers 2022), may also, in conjunction with the proposed near-term Colorado River operations, contribute to cumulative effects on paleontological resources. These would include damage during construction and erosion of paleontologically sensitive sediment, which could unearth and disperse fossils. Exposed resources may be subject to increased wave action, wet/dry cycling, and visitation. Violations of the PRPA by visitors can result in punishments under law. Negative impacts on paleontological resources may be anticipated in the near and long term from increased visitation and unauthorized collection or vandalism. However, with mitigations described in the 10-Year Plan, the project should not contribute to cumulative impacts, in conjunction with the proposed near-term Colorado River operations.

3.13 Biological Resources

3.13.1 Affected Environment

In order to supplement the 2007 FEIS (Reclamation 2007), this section provides a brief summary of a more comprehensive description of the affected environment in the 2007 document, supplementing as necessary to include changes that have occurred since 2007. For additional information, see the 2007 FEIS (Reclamation 2007), the 2016 LTEMP FEIS (Reclamation and NPS 2016), and the LCR MSCP Habitat Conservation Plan (HCP; Reclamation 2004a), which are incorporated by reference.

The elevation gradient, soil types, and flow characteristics along the Colorado River corridor create diverse vegetation and habitat communities that support plants, wildlife, and special status species (Reclamation 2007). Vegetation along the Colorado River is heavily influenced by flow characteristics, which are manipulated through dam operations (Reclamation and NPS 2016). This manipulation of flow characteristics can alter shoreline sand bars and vegetation communities along the Colorado River corridor, thereby impacting plants, wildlife, and special status species.

The vegetation, wildlife, and special status species typical of each section are outlined below, based on the 2007 FEIS; the 2016 LTEMP FEIS (Reclamation and NPS 2016); the LCR MSCP HCP

(Reclamation 2004a); and a query of BLM sensitive species in the natural heritage databases for Utah (BLM 2018), Arizona (BLM 2017a), Nevada (BLM 2017b), and California (BLM 2014).

Vegetation

Circumstances that have resulted in substantial changes to vegetation beyond what was analyzed in the 2007 FEIS in the overall biological resources analysis area include: drought conditions, low inflows, and historically low water levels; the introduction of the tamarisk leaf beetle (*Diorhabda* spp.) to control invasive tamarisk; changes in vegetation community composition below Glen Canyon Dam due to changes in river flow, particularly in alluvial areas; experimental vegetation treatments (per LTEMP ROD) that remove nonnative plants and replace them with native plants at selected sites along the river; and the creation of riparian habitat in conservation areas below Hoover Dam associated with actions conducted by the LCR MSCP. These changes are described below under their respective geographic analysis area.

Lake Powell

As described in the 2007 FEIS, riparian vegetation around Lake Powell is extremely restricted because of the desert terrain that extends directly to the water's edge, and the continuously fluctuating lake elevations. Fluctuations in lake elevations have resulted in standing water and backwater pools in the side canyons of Lake Powell where riparian vegetation has become established. Dominant plants found in these canyons include Fremont cottonwood (*Populus fremontii*), tamarisk (*Tamarix* spp.), and cattail (*Typha* spp.).

Lake Powell is currently operating at a historically low water level due to prolonged drought. Since 2007, the increase in acreage of exposed shoreline has increased Russian thistle (*Salsola* spp.) and tamarisk establishment. Currently, tamarisk and Russian thistle are the dominant vegetation type along the shores of Lake Powell. Dense stands of tamarisk displace native plants, degrade wildlife habitat, reduce livestock forage, limit human access, interfere with the natural fluvial process, change the ecology and hydrology of riparian systems, and increase the risk of severe wildfires (NPS 2023d).

Russian thistle easily takes root in disturbed or bare ground, moving in before native species can establish. Drought conditions like those experienced in recent years only promote the plant's proliferation. The dryness hinders the growth of native species, while the Russian thistle seed requires very little moisture to germinate and grow where native species otherwise would have. This can have deleterious effects on natural ecological functioning and increase the wildfire risk (NPS 2023d).

Springs and seeps are common in alcoves along the walls in GCRNA, as are water pockets located in canyons and uplands. These areas are recognized for their significance as wetland habitats and as unique ecosystems within the desert. These seeps support hanging gardens, which are a specialized vegetation community (Welsh et al. 1987). The water sources that support hanging gardens originate from natural springs and seeps within the Navajo Sandstone formation and are independent of Lake Powell. Livestock grazing is allowed at GCNRA, with the Bureau of Land Management administering the grazing permits. Vegetation monitoring occurs in the upland areas of the recreation area, but no studies have been conducted on the riparian habitat along the lakeshore.

The elevation of Lake Powell can affect fish populations that rely on shoreline habitat, especially sportfish like largemouth bass and crappie. When the reservoir is at moderate to high levels, the shoreline consists of barren rock, sand, and some terrestrial desert vegetation that is used by young bass and crappie as nursery cover when the shoreline floods in spring. With lower reservoir elevations, much of the shoreline is along steep vertical rock talus or steep cliffs and much of the habitat for bass and crappie is gone with subsequent declines in these populations lake wide. The smallmouth bass, however, can reproduce, survive, recruit, and feed well in rocky substrate. The smallmouth bass fry can hide in rocks when danger threatens, whereas largemouth bass and crappie fry must hide in brushy cover to ward off predation. Without brush, largemouth survival is poor but with two thousand miles of rocky shoreline smallmouth bass can thrive. Hence, a lower reservoir elevation can alter fish populations in Lake Powell, and in this case the shoreline condition favors the smallmouth bass (Gustaveson 2018).

Glen Canyon Dam to Lake Mead

Vegetation along the reach of the Colorado River corridor from Glen Canyon Dam to Lake Mead is affected by the peak magnitudes, daily fluctuations, and seasonal pattern of river flows, and most evidence indicates that riparian vegetation composition, structure, distribution, and function are closely tied to ongoing Glen Canyon Dam operations (Reclamation and NPS 2016).

Existing vegetation communities for this reach are described in detail in the LTEMP FEIS (Reclamation and NPS 2016), which provides a framework for managing Glen Canyon Dam operations and experimental actions over a 20-year period. As described in the LTEMP FEIS, terrestrial plant communities along the Colorado River from Glen Canyon Dam to Lake Mead are highly diverse due to great variations in landforms, geologic features, and physical characteristics such as topography, elevation, and aspect. As described in the LTEMP FEIS (Reclamation and NPS 2016), vegetation zones along the river reflect the frequency of inundation and disturbance. The fluctuating zone supports flood-tolerant marsh species, such as sedges, rushes, cattail, horsetail, and common reed. These species occupy return-current channels and successional backwaters that are inundated daily for at least part of the year (i.e., up to the elevation of the average annual daily maximum discharge of about 20,000 cfs). As depicted in Figure 3.6-1 of the LTEMP FEIS (Reclamation and NPS 2016), vegetation in the fluctuating and new high-water zones are greatly influenced by river flow and dam operations. The new high-water zone, inundated by flows up to 45,000 cfs, supports woody riparian species, many herbaceous-obligate riparian species (e.g., *Carex* spp., *Juncus* spp., *Equisetum* spp., *Phragmites australis*, and *Typha* spp.), with bunchgrasses such as sand dropseed and shrubs such as spiny aster at upper elevations.

Riparian vegetation communities can be affected by dam operations through scouring and erosion during high flows, drowning, burial by new sediments, and reductions in soil moisture levels; consistent availability of water at low elevations (e.g., below 25,000 cfs) from elevated base flows can promote vegetation growth. Responses of riparian vegetation are affected by the timing, frequency, duration, and magnitude of the river's hydrology, as well as the variability between years and sequencing of flows (Palmquist et al. 2018). Additional factors related to flow that influence riparian vegetation include characteristics of deposited sediments (such as water-holding capacity, aeration, and nutrient levels), depth to groundwater, and anoxia in the root zone. The export of sediments (particularly silts and clays and organic matter) was observed to coarsen substrates, affect nutrient

concentrations, and reduce opportunities for subsequent recruitment of tamarisk and native shrubs such as coyote willow and Emory seepwillow (Reclamation and NPS 2016).

During development of the LTEMP FEIS, the effects of dam operations on riparian vegetation health along the river corridor were evaluated, and modeling results suggested long-term declines, particularly in native plant communities. With operational flows limited to less than 45,000 cfs, the overall extent and health of the riparian areas in GCNP have been and would continue to be altered, and nonnative vegetation and monoculture species would likely increase. Therefore, a 20-year experimental riparian-restoration project was developed by the NPS and other agencies, as designated in the environmental commitments of the LTEMP ROD. The restoration projects specifically seek to address the following four specific vegetation issues that emerged in the LTEMP FEIS as being influenced by dam operations: (1) encroachment of vegetation on sandbars, (2) decrease in native plant species, (3) erosion of archaeological resources, and (4) narrowing and loss of plants in the old high-water zone (Reclamation and NPS 2016). Implementation of High Flow Experiments (HFEs) under the LTEMP have influenced riparian vegetation in this reach. In 2012 an HFE protocol was developed to improve sediment conservation downstream of the Paria River. This protocol was adopted under the LTEMP and has influenced riparian vegetation in this reach. Since 2012, six HFEs have been conducted, the most recent being in April 2023. In August 2021, the NPS, in coordination with Grand Canyon Monitoring and Research Center (GCMRC), developed a Long Term Experimental and Management Plan Riparian Vegetation Project Plan that provides guidance for nonflow experimental vegetation treatments to accomplish the following objectives: (1) control nonnative plant species affected by dam operations, including tamarisk and other highly invasive species; (2) develop native plant materials for replanting through partnerships and the use of regional greenhouses; (3) replant native plant species to priority sites along the river corridor, including native species of interest to Tribes; (4) remove vegetation encroaching on campsites; and (5) manage vegetation to assist with cultural site protection.

Lake Mead

The highest concentration of vegetated habitat associated with Lake Mead is found in the Colorado and Virgin River deltas. Fluctuating lake elevations influence the shoreline vegetation. Riparian vegetation that does develop within the range of Lake Mead elevation fluctuations is temporary, as fluctuating lake elevations either dewater or inundate these areas through time. Linear riparian woodlands may be present along the shoreline of the Lake Mead delta following high-water flows and associated sediment deposition and exposure. The sediment deposition and the associated growth of riparian vegetation at the Lake Mead delta has occurred for decades. However, riparian vegetation is historically thought to be sparse, even along much of the historical Colorado River corridor that Lake Mead submerged, and much of the existing shoreline is sparsely vegetated (Engel et al. 2014).

Water levels at Lake Mead have declined to some of the lowest elevations for an extended period of time due to prolonged drought. Decreasing water levels reduce the lake perimeter while increasing the amount of shoreline area relative to the unsubmerged amount when the lake is at full pool. The consistent decline in water level since 1998 has prevented the establishment of a stable riparian community. The drawdown of Lake Mead from 1998 to 2011 reduced the lake's perimeter by more than 248 miles (400 kilometers) while exposing more than 61,776 acres (25,000 hectares) of formerly

submerged land. Engel et al. (2014) observed that, consistent with previous research, the abundance of the tamarisk declined with increasing surface age. Conversely, the cover of native species was greatest overall on older surfaces across sites. Early successional native perennial species colonized the 13-year-old surface. While Lake Mead's drawdown might be viewed negatively from a perspective of maintaining full pool water storage, it has re-exposed a vast area of new terrestrial habitat increasingly colonized by native species as invasive species abundance declines through time (Engel et al. 2014).

The vegetation at Lake Mead has also been influenced by defoliation from the tamarisk leaf beetle. Beetles were released along the Virgin River in St. George, Utah, in 2006, and widespread defoliation of tamarisk was first observed in St. George in 2008. The area of tamarisk defoliation on the Virgin River expanded downstream annually, encompassing the entire stretch of the Virgin River to Lake Mead, Nevada, by the end of the breeding season in 2011.

Hoover Dam to SIB

Vegetation for this reach is described in detail in the LCR MSCP HCP (Reclamation 2004a). Fourteen land cover types are described in the LCR MSCP planning area. Five woody riparian types are divided into multiple structural types, and the marsh land cover type is divided into seven compositional types based on plant composition and vegetation structure. . A summary of the land cover types and their characteristics, found from Lake Mead to the SIB, is provided below in **Table 3-24** and in more detail in Section 3.4 of the LCR MSCP HCP (Reclamation 2004a).

Since released in 2006, tamarisk beetles have continued to spread downstream from Lake Mead along the LCR, and by 2019, large beetle populations were detected along the Imperial stretch of the LCR. In 2020, tamarisk beetles were present, and defoliation was documented in or around all LCR MSCP study areas (Reclamation 2021c).

Table 3-24
Summary of Vegetation Cover Types from Lake Mead to the SIB

Vegetation Type	Characteristics
Woody Riparian	
Cottonwood-willow (6 structural types)	Gooding willow and cottonwood at least 10 percent of total trees
Saltcedar (6 structural types)	Saltcedar species constituting 80 to 90 percent of total trees
Honey Mesquite (4 structural types)	Honey mesquite constituting 90 to 100 percent of trees
Saltcedar-honey mesquite (4 structural types)	Honey mesquite at least 10 percent of total trees (usually)
Saltcedar-screwbean mesquite (5 structural types)	Screwbean mesquite at least 20 percent of total trees
Arrowweed	Arrowweed at least 90 to 100 percent of total vegetation
Atriplex	Saltbush species constituting 90 to 100 percent of total vegetation

Vegetation Type	Characteristics
Marsh (7 compositional types)	Cattail/bulrush, little common reed, trees and grasses, and open water
Desert Scrub	Adjacent to riparian and aquatic land cover types
Agriculture	Active or fallow, adjacent to riparian and aquatic land cover types
Developed	Buildings, roads, campgrounds, landscaped areas

Source: Reclamation 2007

The LCR MSCP has adopted a habitat-based approach to the conservation of covered species. Riparian communities identified in the LCR MSCP HCP as covered species habitat include cottonwood-willow, honey mesquite, marsh, and backwater land cover types. The HCP requires the creation of over 8,100 acres (3,277 hectares) of various land cover types to provide habitat for targeted LCR MSCP covered species. Since 2006, over 3,000,000 cottonwood and willow trees have been established within conservation areas in addition to a host of other varieties such as honey mesquite, wetlands plants, and salt grass plugs. As of 2021, a total of 4,274 acres of cottonwood-willow, 2,046 acres of mesquite, 362 acres of marsh, and 158 acres of backwater have been established and are managed by the LCR MSCP (LCR MSCP 2022).

Salton Sea

The Salton Sea currently contains a mix of saltwater and freshwater habitats, marshes, desert upland, and ryegrass fields (Service 2023). Permanent wetlands are around the Salton Sea where the agricultural drains back up or flood, or where land is deliberately flooded for habitat. Vegetation varies from invasive species, such as tamarisk, to cattails (*Typha* spp.) and bulrush (*Scirpus* spp.). Exposed dry playa near the water shoreline consists of sparse vegetation and woody debris. Sparsely vegetated mudflat, sandflat, and beach habitat also occurs near the shoreline.

Over the past decades, the Salton Sea's water level has been declining, and it has been the subject of various modeling efforts to quantify the decline, assess environmental impacts, and evaluate various mitigation and conservation efforts.

Wildlife

Lake Powell

Lake Powell and its associated upland habitat support a wide variety of wildlife species. The limited riparian habitat around Lake Powell is a highly valuable resource for wildlife species dependent on riparian habitat in this portion of the analysis area. The 2007 FEIS lists common amphibians (e.g., Canyon tree frog [*Hyla arenicolor*]), aquatic and riparian birds (e.g., American wigeon [*Anas americana*]), and mammal species (e.g., beavers [*Castor canadensis*]) found in Lake Powell and its associated upland habitat (Reclamation 2007).

Lake Powell is the second-largest impoundment on the Colorado River, and it provides habitat for primarily lacustrine fish species. However, inflows to the lake also provide riverine habitat for various fish species. The fish community in Lake Powell is dominated by nonnative species, with a total of fourteen nonnative species (Reclamation 2007). Recreational fishing is an important industry in the Colorado River, and Lake Powell supports a sport fishery for striped bass (*Morone saxatilis*),

largemouth bass (*Micropterus salmoides*), walleye (*Sander vitreus*), and smallmouth bass (*Micropterus dolomieui*). Management actions in this reservoir have also introduced nonnative forage fish to support this sport fishery. Five species of native fish have been found in Lake Powell, including the flannelmouth sucker *(Catostomous latipinnis*), razorback sucker (*Xyrauchen texanus*), Colorado pikeminnow *(Ptychocheilus lucius*), bonytail (*Gila elegans*), and speckled dace (*Rhinichthys osculus*) (Valdez and Williams 1993; Karp and Mueller 2002; Durst and Francis 2016).

Deltaic deposits have formed in the inflows of the Colorado and San Juan Rivers, and new river habitat has become exposed with receding lake levels in the past 20 years. These rivers have carved new channels into the deposits and expanded riparian areas and the riverine habitat of fish, including native and nonnative species. In the Colorado River, riverine habitat has been expanded by about 35 miles (56 kilometers) relative to full pool. In the San Juan River inflow, riverine habitat has been expanded by about 30 miles (48 kilometers) and a 20-foot (6-meter) waterfall has formed at the upper end that now prevents upstream movement by fish. The current waterfall emerged in 2001 and has only been inundated (thus passable) once, in 2011 for 2 weeks in late July and mid-August (Durst and Francis 2016).

At the time of the FEIS (Reclamation 2007), it was unclear whether zebra mussels or quagga mussels were established in Lake Powell. Quagga mussels were discovered in 2012, however, and sampling in subsequent years (2014–2019) indicated that this species has continued to spread throughout the reservoir (Utah Department of Natural Resources 2021). The Asian clam (*Corbicula fluminea*) is also an invasive bivalve of Lake Powell, first reported in the lake in the mid to late 1900s. The Asian clam and the quagga mussel each filter large amounts of nutrients from a water body and can accumulate in large numbers that can clog canals, ditches, and other water infrastructures. The National Park Service has also identified several species of invasive invertebrates, including the virile crayfish (*Orconectes virilis*).

Glen Canyon Dam to Lake Mead

The terrestrial habitat from Glen Canyon Dam to Lake Mead is predominantly canyon habitat, including portions of GCNRA and GCNP. Canyon habitat provides a variety of vegetation types that support upland and obligate riparian species. Riparian habitat is more common along this stretch of the Colorado River compared with Lake Powell. Vegetation in this section is dominated by the invasive tamarisk plant; however, the introduction of the tamarisk leaf beetle has had recent impacts along this stretch of the river, changing community composition and reducing tamarisk cover. The beetle will likely play a large role in habitat composition over the next several years (Reclamation and NPS 2016, Bransky et al. 2021). Many species of amphibians (e.g., canyon tree frog [*Hyla arenicolor*], red-spotted toad [*Bufo punctatus*], and Woodhouse's toad [*Bufo woodhousii*]), aquatic and riparian birds (e.g., yellow warbler [*Dendroica petechia*], great blue heron [*Ardea herodias*], and osprey [*Pandion haliaetus*]), and mammal species (e.g., coyote [*Canis latrans*], desert bighorn sheep [*Ovis canadensis nelsoni*], muskrat [*Ondatra canadensis*], and American beaver [*Castor canadensis*]) are found in this portion of the analysis area and its associated upland habitat (Reclamation 2007; Holm et al. 2023).

For aquatic species, this section includes the Colorado River below Glen Canyon Dam through Grand Canyon for approximately 290 miles (466 kilometers) and the Lake Mead inflow for an

additional 25 miles (40 kilometers). A large rapid has formed near Pearce Ferry (river mile [RM] 280) that serves as a partial barrier to upstream fish movement. The entire reach from the dam to Lake Mead includes approximately eighteen species of nonnative fish and five native species (Valdez and Carothers 1998). A large reproducing population of humpback chub (*Gila cypha*) in the Colorado River system is found in the Little Colorado River. Translocated populations occur in Havasu and Bright Angel Creeks. A larger and relatively recent population of humpback chub has been identified in the western Grand Canyon (Van Havebeke et al. 2017, 2022; Dzul et al. 2023). Razorback sucker (*Xyrauchen texanus*) occur primarily downstream of Lava Falls Rapid (RM 180) but have been detected beginning at RM 127 (above Lava Falls). Sonic-tagged razorback sucker were released at Bright Angel Creek in 2021, and one of them was detected at the mouth of this creek in 2022.

A Blue Ribbon trout fishery consisting of rainbow trout exists in the 15 miles (24 kilometers) of river below Glen Canyon Dam (Lees Ferry), although in recent years populations of brown trout, a more predatory species of trout, have been increasing (Runge et al 2018) and rainbow trout populations are declining (Yard et al. 2023). Smallmouth bass, which are an invasive and predatory fish, were detected below Glen Canyon Dam in the summer of 2022. Though they had been detected below the dam previously, warmer water temperatures created conditions suitable for reproduction of smallmouth bass in 2022 and 2023.

The Lake Mead inflow is characterized by deltaic sediments exposed with the declining lake level, through which the river has carved a channel. This new river channel has expanded riverine habitat by about 40 miles (64 kilometers) from approximately Separation Canyon to below Pearce Ferry. A large rapid has formed near Pearce Ferry (RM 280) that serves as a partial barrier to upstream fish movement.

In addition to smallmouth bass, green sunfish, walleye, striped bass, bluegill, and black crappie were detected in 2022 below Glen Canyon Dam in higher numbers than is typically observed. When the reservoir level is close (at approximately 3,520 feet) to the level of the penstocks (3,470 feet) there is concern that the risk of nonnative fish entrainment (passing through the dam) increases (Reclamation 2022f). The warmwater invasive species also potentially will persist below GCD due to warmer water releases from Glen Canyon Dam.

Quagga mussels were not considered an issue in this section due to the riverine habitat (Reclamation 2007), but the species has been found downstream of Glen Canyon Dam. McDaniel et al. (2021) documented quagga mussel densities greater than 3,000/m^2 in the Glen Canyon Dam tailwaters, and many thousands/L of veligers were reported by the NPS passing through Glen Canyon Dam. Low flows are likely to mean prolonged periods of clear water through Grand Canyon, conditions that will facilitate at least sporadic quagga mussel invasion of the river corridor and perhaps via human transport, upstream into the perennial tributaries in Grand Canyon.

The New Zealand mudsnail (*Potamopyrgus antipodarum*) has recently been documented in the Colorado River downstream of Glen Canyon Dam (Cross et al. 2010) and has been increasing in distribution and abundance.

Lake Mead

Similar to Lake Powell, Lake Mead and its associated upland habitat support a wide variety of wildlife species. Riparian habitat in the Lake Mead section is generally limited to the Lake Mead and Virgin River deltas. These areas undergo frequent water level fluctuation, which results in fluctuating riparian habitat availability. The 2007 FEIS refers to the Lake Mead section of the analysis area as having similar common wildlife species as the Lake Powell section and the Glen Canyon Dam to Lake Mead section of the analysis area (Reclamation 2007).

With declining lake elevations in the last 20 years, the Colorado and Virgin Rivers have expanded as river channels carved into the deltaic sediment deposits. The Colorado River inflow has expanded in length about 40 miles (64 kilometers), from full pool elevation at Separation Canyon downstream to Pearce Ferry, and the Virgin River has expanded about 20 miles (32 kilometers), providing additional riverine habitat for aquatic species. The largest population of humpback chub in the Colorado River system has recently become established in this newly carved channel. Lake Mead provides lacustrine habitat for nonnative and native fish species. The lake supports a sport fishery for primarily striped bass, largemouth bass, crappie, bluegill, and catfish. Lake Mead also supports the only self-sustaining population of razorback suckers in the Colorado River system, with most of the fish found in the Colorado River and Virgin River inflows (Albrecht et al. 2017).

Both Lake Mead and Lake Mohave have experienced algal blooms since the early 2000s. These blooms are the result of nutrients within the Colorado River generally derived from decaying vegetation in the largely undeveloped watershed as well as nutrients from the Virgin River, Muddy River, and Las Vegas Wash. These nutrients arrive in the form of treated wastewater, urban runoff, and agricultural runoff. Lower lake levels affect lake nutrients and nutrient dynamics, which in turn affect the amounts and location of algae produced in these reservoirs. Starting in the year 2000, the wastewater treatment plants along Las Vegas Wash have enhanced their phosphorus removal, improving water quality and reducing the potential for algal blooms. Monitoring has revealed that these blooms include blue-green algae, which bloomed in large amounts in 2011–2015 and again in recent years since 2020. Blue-green algae produces a toxin called microcystin that can cause health issues in people and wildlife. The effects of these algal blooms on fish and wildlife are not well understood, and monitoring will need to be continued to better understand the relationship between reservoir elevations, algal blooms, and effects on fish populations in both Lake Mead and Lake Mohave.

In 2007, quagga mussels were documented in Lake Mead (Reclamation 2007), and they persist there.

Hoover Dam to the SIB

The lower section of the Colorado River supports diverse habitat types, which in turn support a variety of wildlife species. Restoration activities described in the LCR MSCP have increased the amount of desirable habitat communities, including riparian vegetation, marsh habitat, backwater habitat, and wetlands (Reclamation 2004a). The 2007 FEIS lists common amphibians (e.g., bullfrog [*Rana catesbeiana*]), aquatic and riparian birds (e.g., avocet [*Recurvirostra americana*]), and mammal species (e.g., bobcat [*Felis rufus*]) found in this portion of the analysis area and its associated upland habitat (Reclamation 2007).

Fish habitat exists in this section where surface water is perennial. This section is dominated by nonnative species (Reclamation 2007).

Dense infestations of quagga mussels occur at every major reservoir along the lower Colorado River (Pucherelli et al. 2016). However, similar infestations downriver of Parker Dam have not been reported. Studies indicate that increased temperature and total suspended solids (turbidity) at downstream sites are likely contributing to reduced mussel settlement and survival. Conductivity also increases at southern sites, and experiments conducted at Davis Dam indicate that increased conductivity levels similar to those observed at Imperial Dam can lead to a slight decrease in settlement. Additional findings indicate that nutrient parameters may not be predictive of veliger survival and abundance in river systems.

The Asian clam (*Corbicula fluminea*) is also an invasive bivalve of Lake Mead, first reported in the lake around 1955. The Asian clam and the quagga mussel each filter large amounts of nutrients from a water body and can accumulate in high numbers that can clog canals, ditches, and other water infrastructures.

Salton Sea

The Salton Sea is an important migratory stopover site for birds (Service 2023). Over 400 bird species have been recorded at the Salton Sea, and the area is considered an Audubon Important Bird Area of global significance. While the Salton Sea primarily supports migratory birds, 109 species are year-round residents (Service 2023).

The Salton Sea provides globally important shorebird habitat. Over 100,000 shorebirds of 25 different species utilize the Salton Sea during annual migration, making it one of the most important shorebird habitat areas west of the Rocky Mountains (Service 2023). Common species include western sandpiper (*Calidris mauri*), willet (*Tringa semipalmata*), least sandpiper (*Calidris mantilla*), American avocet (*Recurvirostra americana*), dowitchers (*Limnodromus* spp.), red-necked phalarope (*Phalaropus lobatus*), whimbrel (*Numenius phaeopus*), and black-necked stilt (*Himantopus mexicanus*) (Service 2023). Amphibians are not very common around the Salton Sea, with only a few species generally found on the Sonny Bono Salton Sea National Wildlife Refuge. The most common species include bullfrogs, but there have been records of Woodhouse's toads and red-spotted toads (Service 2023).

Given the dry desert habitat surrounding the Salton Sea (see the Vegetation section for a discussion of habitat types), reptiles are more common around the Salton Sea than amphibians. Common species include snakes, such as gopher snake (*Pituophis catenifer*) and western diamondback rattlesnake (*Crotalus atrox*); lizards, such as whiptail lizard (*Aspidoscelis* sp.) and side-blotched lizard (*Uta stansburiana*); and turtles, such as spiny soft-shell turtle (*Apalone spiniferus*) (Service 2023).

Common mammal species include desert cottontail (*Sylvilagus audubonii*), raccoon (*Procyon lotor*), muskrat, striped skunk (*Mephitis mephitis*), bobcat, coyote, and several bat and small rodent species (Service 2023).

The Salton Sea is characterized as a hypersaline water body. The California Department of Fish and Wildlife (CDFW) conducted quarterly fish surveys of the Salton Sea between 2003 and 2008, after

which that project was discontinued. Data from these surveys captured species including tilapia, mollies, mullet, pupfish (unreported species), shad (unreported species), striped bass (*Morone saxitilis*), corvina (*Cynoscion xanthulus*), and Gulf croaker (*Bairdiella icistia*). Between 2003 and 2008, captures were dominated by tilapia (a total of 55,613), croaker (a total of 80), and corvina (a total of 19). During the last year of surveys in 2008, however, only two species were captured, including 14,380 tilapia and 2 mollies. Tilapia species present in the Salton Sea are redbelly (*Tilapia zillii*), Mozambique tilapia (*Oreochromis mossambicus*), and their hybrid (Riedel 2016).

The most recent survey of the Salton Sea was conducted jointly by the CDFW and Service in 2017; this survey captured only tilapia. A total of 327 tilapia were captured with 3 size classes present, indicating successful recent spawning (CDFW and USFWS 2017). While 327 tilapia were captured in 2017, this total and catch-per-unit-effort (CPUE) of 1.11 fish per net hour for 2017 were very low compared with previous years (2003–2008), especially when compared with site-specific CPUE for 2008.

Many freshwater species were extirpated by 1929 when the Salton Sea became increasingly saline from irrigation return flows (Evermann 1916; Riedel 2016). Current conditions may not be habitable by many species due to the water's high and increasing salinity. This trend of increasing salinity may result in the extirpation of tilapia as well (Riedel 2016). Salinity refuges are localized around confluences with streams, and these areas may be extremely important for the continued persistence of fish in the Salton Sea (Riedel 2016). The 2017 survey (CDFW and USFWS 2017) captured the most tilapia around the freshwater inputs, thus indicating these inflows may be important for the persistence of fish in the Salton Sea, especially with lower salinities in these areas.

Special Status Species

Special status species include federally threatened, endangered, or proposed species as well as species on the state BLM sensitive species lists for Utah (BLM 2018), Arizona (BLM 2017a), Nevada (BLM 2017b), and California (BLM 2014). Species on these lists were queried with the state natural heritage databases for each of the four states to determine which species had records in the analysis area. Only those species identified as present in the natural heritage databases were included in this analysis. The resulting data were used to populate **Table 3-25** and **Table 3-26**.

See the vegetation and general wildlife sections for a description of habitat within each of the four sections of the analysis area, as these descriptions are not repeated below. For habitat requirements for the species in **Table 3-25** and **Table 3-26**, see NatureServe Explorer (2023) (www.natureserve.com). Biological assessments have been submitted to USFWS and consultation is on-going. ESA species are addressed in the biological assessment and will be addressed in the biological opinion. Avoidance, minimization, and mitigation measures are outlined in the biological assessment and biological opinion. Updated information will be incorporated into the final SEIS or ROD when it is available.

Table 3-25
Federally Listed Species Potentially Affected by the Alternatives

Common Name	Scientific Name	Listing Status	Location				
			Lake Powell	Glen Canyon Dam to Lake Mead	Lake Mead	Hoover Dam to the SIB	Salton Sea
Fish							
Bonytail chub	*Gila elegans*	Endangered BLM NV	Present (rare, stocked)	—	—	Present (stocked)	—
Colorado pikeminnow	*Ptychocheilus lucius*	Endangered	Present (rare in lake, common in inflows)	—	—	—	—
Humpback chub	*Gila cypha*	Threatened	—	Present	Present (new population below full pool elevation in Colorado River Inflow)	—	—
Razorback sucker	*Xyrauchen texanus*	Endangered BLM NV	Present	Present (primarily below Lava Falls Rapid)	Present	Present	—
Desert pupfish	*Cyprinodon macularius*	Endangered CA	—	—	—	Present in small numbers in riverside marshes	Present in agriculture drains (not reported in Salton Sea since 2007)
Woundfin	*Plagopterus argentissimus*	Endangered	—	—	X (found in Virgin River upstream of project area)	—	—
Birds							
Southwestern willow flycatcher	*Empidonax traillii extimus*	Endangered BLM AZ BLM CA BLM NV	No habitat present for this species	Present (breeding habitat limited to areas unaffected by water fluctuations)	Habitat only in Lower Las Vegas Wash within full pool of Lake Mead	Present	No breeding habitat present for this species
Western yellow-billed cuckoo	*Coccyzus americanus*	Threatened BLM AZ BLM CA BLM NV	No habitat present for this species	Present (possible breeding habitat limited to areas unaffected by water fluctuations)	Habitat only in Lower Las Vegas Wash within full pool of Lake Mead	Habitat in LCR MSCP conservation areas	No breeding habitat present for this species

Common Name	Scientific Name	Listing Status	Location				
			Lake Powell	Glen Canyon Dam to Lake Mead	Lake Mead	Hoover Dam to the SIB	Salton Sea
Yuma Ridgway's rail	*Rallus obsoletus yumanensis*	Endangered BLM AZ BLM CA BLM NV	No habitat present for this species	No habitat present that could be affected by water fluctuations	No habitat present that could be affected by water fluctuations	Present	Present
Mammals							
None	—	—	—	—	—	—	—
Reptiles and Amphibians							
Desert tortoise	*Gopherus agassizii*	Threatened BLM NV	Not present	Not present	Present	Present	Not present
Northern Mexican garter snake	*Thamnophis eques megalops*	Threatened	Not present	Not present	Not present	Present	Not Present
Invertebrates							
None	—	—	—	—	—	—	—
Plants							
None	—	—	—	—	—	—	—

Table 3-26
Non-ESA-listed Special Status Species Potentially Affected by the Alternatives

Common Name	Scientific Name	Status	Location				
			Lake Powell	Glen Canyon Dam to Lake Mead	Lake Mead	Hoover Dam to the SIB	Salton Sea
Fish							
Bluehead sucker	*Catostomus discobolus*	BLM AZ BLM UT	—	X	X (rare)	—	—
Desert sucker	*Catostomus clarkii*	BLM AZ	—	—	—	X (found in tributaries)	—
Flannelmouth sucker	*Catostomus latipinnis*	BLM AZ BLM UT	X	X	X	X	—
Gila longfin dace	*Agosia chrysogaster chrysogaster*	BLM AZ	—	—	—	X (found in tributaries)	—
Sonora sucker	*Catostomus insignis*	None	—	—	—	X (found in tributaries)	—
Speckled dace	*Rhinichthys osculus*	BLM AZ	X (rare)	X	X	X	—
Virgin spinedace	*Lepidomeda mollispinis*	None	—	—	X (found in Virgin River upstream of project area)	—	—
Birds							
American white pelican	*Pelecanus erythrorhynchos*	BLM UT	X	—	—	X[1]	X
Arizona bell's vireo	*Vireo bellii arizonae*	BLM CA	—	X	—	X	—
Bald eagle	*Haliaeetus leucocephalus*	BLM AZ BLM NV BLM UT	X	X	X	X	—

Common Name	Scientific Name	Status	Location				
			Lake Powell	Glen Canyon Dam to Lake Mead	Lake Mead	Hoover Dam to the SIB	Salton Sea
California black rail	*Laterallus jamaicensis coturniculus*	BLM AZ BLM CA	—	—	—	X	X
California condor	*Gymnogyps californianus*	BLM AZ	X	X	—	—	—
Crissal thrasher	*Toxostoma crissale*	BLM CA	—	—	—	X	X
Elf owl	*Micrathene whitneyi*	BLM CA	—	—	—	X	—
Gila woodpecker	*Melanerpes uropygialis*	BLM CA	—	—	—	X	—
Gilded flicker	*Colaptes chrysoides*	BLM AZ BLM CA	—	—	—	X	—
Golden eagle	*Aquila chrysaetos*	BLM UT BLM AZ	X	X	X[1]	X	—
Lucy's warbler	*Leiothlypis luciae*	BLM CA	X	—	—	X	—
Mountain plover	*Charadrius montanus*	BLM CA	—	—	—	X	X
Tricolored blackbird	*Agelaius tricolor*	BLM CA	—	—	—	X	—
White-tailed kite	*Elanus leucurus*	BLM CA	—	—	—	X	X
Mammals							
Allen's big-eared bat	*Idionycteris (=Plecotus) phyllotis*	BLM AZ BLM NV BLM UT	X	—	X	—	—
Allen's lappet-browed bat	*Idionycteris phyllotis*	BLM AZ	—	X	—	—	—
Arizona myotis	*Myotis occultus*	BLM AZ	—	X	X	X	—
Big brown bat	*Eptesicus fuscus*	BLM NV	X	X	X	X[1]	—
Big free-tailed bat	*Nyctinomops macrotis*	BLM NV	—	—	X	X[1]	—
California leaf-nosed bat	*Macrotus californicus*	BLM AZ BLM NV	—	—	X	X	—
California myotis	*Myotis californicus*	BLM NV	X	X	X	X[1]	—
Canyon bat	*Parastrellus hesperus*	BLM NV	X	X	X	X[1]	—
Cave myotis	*Myotis velifer*	BLM AZ BLM NV	X	X	X	X	—
Desert bighorn sheep	*Ovis canadensis nelsoni*	BLM CA	X	X	X	X	—
Fringed myotis	*Myotis thysanodes*	BLM UT BLM NV	X	X	X	—	—
Hoary bat	*Lasiurus cinereus*	BLM NV	X	—	X	X[1]	—
Long-eared myotis	*Myotis evotis*	BLM CA	—	—	—	X	—
Mexican free-tailed bat	*Tadarida brasiliensis*	BLM NV	X	X	X	X[1]	—
Mexican long-tongued bat	Choeronycteris mexicana	BLM AZ	—	X	—	X	—
Pale Townsend's big-eared bat	*Corynorhinus townsendii pallescens*	BLM AZ	X	X	X	X	—
Pallid bat	*Antrozous pallidus*	BLM NV	X	X	X	X	—

Common Name	Scientific Name	Status	Location				
			Lake Powell	Glen Canyon Dam to Lake Mead	Lake Mead	Hoover Dam to the SIB	Salton Sea
Silver-haired bat	*Lasionycteris noctivagans*	BLM NV	X	X	X	X[1]	—
Spotted bat	*Euderma maculatum*	BLM AZ BLM NV BLM UT	—	X	—	X	—
Townsend's big-eared bat	*Corynorhinus townsendii*	BLM AZ BLM CA BLM NV BLM UT	X	—	X	X	—
Western mastiff bat	*Eumops perotis*	BLM AZ BLM NV	—	X	X	X	—
Western red bat	*Lasiurus blossevillii*	BLM NV BLM UT	—	—	X	X[1]	—
Western small-footed myotis	*Myotis ciliolabrum*	BLM CA BLM NV	—	—	X	X	—
Yuma myotis	*Myotis yumanensis*	BLM CA BLM NV	X	X	X	X	—
Reptiles and Amphibians							
Arizona toad	*Anaxyrus microscaphus*	BLM AZ BLM UT BLM NV	X	—	—	X	—
Couch's spadefoot	*Scaphiopus couchii*	BLM CA	—	—	—	X	—
Lowland leopard frog	*Rana yavapaiensis*	BLM AZ BLM CA	—	—	X	X	—
Relict leopard frog	*Rana onca*	BLM AZ BLM NV	—	X	X	X	—
Invertebrates							
Mojave poppy bee	*Perdita meconis*	BLM NV	—	—	X	—	—
Monarch butterfly	*Danaus plexippus plexippus*	Candidate BLM NV	X	X	X	X	—
Plants							
Gold butte moss	*Ceratodon purpureus*	BLM NV	—	—	X	—	—
Mojave tarplant	*Deinandra mohavensis*	BLM CA	—	—	—	X	—
Mokiak milkvetch	*Astragalus mokiacensis*	BLM NV	—	—	X	—	—
Parish's meadowfern	*Limnanthes alba* ssp. *parishi*	BLM CA	—	—	—	X	—
Sticky buckwheat	*Eriogonum viscidulum*	BLM AZ BLM NV	—	—	X	—	—
Variegated dudleya	*Dudleya variegata*	BLM CA	—	—	—	X	—

[1]Additional location information received from personal communication with Carolyn Ronning, Wildlife Group Manager, Reclamation, on March 3, 2023

[2]Additional location information received from the NPS (2023b)

Lake Powell

Table 3-25 lists all federally threatened, endangered, or proposed species and whether they occupy Lake Powell. **Table 3-26** lists all non-ESA-listed BLM special status species and whether they occupy Lake Powell.

In the Colorado River inflow to Lake Powell, Colorado pikeminnow have been historically found as larvae and age-0 fish (Valdez and Williams 1993) that were transported from upstream; however, since 2014 no larvae were identified in the Colorado River or San Juan River arms of Lake Powell (Steven Platania, personal communication, 2023). Periodically, large adult Colorado pikeminnow are found in the inflow as transient members of upstream populations in the Green and Upper Colorado Rivers (Service 2022). Razorback suckers are also found in the river inflows of Lake Powell. These fish are usually found as adults from upstream populations, and there are some fish that move across Lake Powell from the San Juan inflow (Service 2018a). Razorback sucker have also been captured in Lake Powell near the Glen Canyon Dam forebay; a recent capture in August 2023 by Utah State University (Barrett Friesen, personal communication, August 13, 2023). Excess numbers of bonytail from the Wahweap State Fish Hatchery (Utah) are released periodically into Lake Powell, but they are not part of a formal stocking plan (Smith 2022).

Colorado pikeminnow are stocked in the San Juan River annually as juveniles (Service 2022), and razorback sucker are stocked as large subadults. These fish are successfully reproducing in the San Juan River, but survival of young and recruitment of both species are low. These populations are currently maintained through stocking. Some fish are displaced from upstream populations into the Lake Powell inflow, and they are prevented from returning upstream by a 20-foot (6-meter) waterfall that has formed as the river has partly carved a new channel on the deltaic sediments. Razorback suckers have been detected in the approximately 30 miles of newly carved river each in the San Juan River and Colorado River inflows while Colorado pikeminnow have been detected sporadically.

Glen Canyon Dam to Lake Mead

Table 3-25 lists all federally threatened, endangered, or proposed species and whether they occupy the Glen Canyon Dam to Lake Mead section. **Table 3-26** lists all non-ESA-listed BLM special status species and whether they occupy the Glen Canyon Dam to Lake Mead section. The *Impact Analysis Area* discussion in **Section 3.13.2** explains the methodology for narrowing down this list from the broader list of species included in **Appendix G**, Table of Sensitive Species. The NPS also identified special status species in Grand Canyon National Park that are not on the BLM sensitive species list (NPS 2023e). These species include the Grand Canyon cave pseudoscorpion (*Archeolarca cavicola*), Kanab ambersnail (*Oxyloma haydeni kanabensis*), Niobrara ambersnail (*Ocylom ahydeni*), long-legged myotis bat (*Myotis volans*), pocketed free-tailed bat (*Nyctinomops fermosacca*), southwestern myotis bat (*Myotis auriculus*), southwestern river otter (*Lontra canadensis sonora*), and several plant species (NPS 2023e). For habitat requirements of these species, see NatureServe Explorer (2023). Impacts on these species will be captured through the analysis of BLM sensitive species that use the same habitat types in the Glen Canyon Dam to Lake Mead sections.

The flannelmouth sucker and bluehead sucker are "conservation species" that are included in a rangewide conservation agreement among six states (Utah Department of Natural Resources 2006). These species are found as self-sustaining populations and are locally common in the Colorado

River from Glen Canyon Dam to Lake Mead. They are seasonally abundant during spring spawning runs into tributaries of the Colorado River, such as the Paria River, Havasu Creek, and Tapeats Creek. Both species have adjusted to changing riverine conditions following construction of Glen Canyon Dam (Paukert and Rogers 2004; Valdez and Carothers 1998). Speckled dace are common to abundant locally in and near tributary inflows, as well as on rocky debris fans formed by debris flows from side canyons (Valdez and Ryel 1995).

Humpback chub populations have recently expanded into the western Grand Canyon. This is likely due to the warmer water in the lower Grand Canyon and due to the lack of predators (Van Haverbeke et al. 2017; Rogowski et al. 2018). The most recent information as of 2023 shows a population of 40,000–60,000 adults between Havasu Rapids and Pearce Ferry (Dzul et al 2023).

Since 2000, larvae and adult razorback suckers have also been found in the Colorado River inflow at the lower end of the Grand Canyon, including sonic-tagged adults moving from one of the three Lake Mead populations (Kegerries et al. 2017). A confirmed spawning site was located in 2010 about 10 miles downstream of Pearce Ferry (Valdez et al. 2012). Although annual surveys for larval and small-bodied razorback suckers have been conducted in the Grand Canyon since 2014, no small-bodied fish have been detected and larval fish have not been detected since 2019. The razorback sucker in the Grand Canyon is found primarily downstream of Lava Falls Rapid.

Lake Mead

Table 3-25 lists all federally threatened, endangered, or proposed species and whether they occupy Lake Mead. **Table 3-26** lists all non-ESA-listed BLM special status species and whether they occupy Lake Mead.

Two native sucker species, flannelmouth sucker and razorback sucker, occupy this area (Reclamation 2007). The only self-sustaining population of razorback sucker in the Lower Basin is found in Lake Mead, primarily in the Colorado River and Virgin River inflows. Colorado pikeminnow do not occur in this reach.

Humpback chub have become established in the Colorado River extended channel as far downstream as below Pearce Ferry (Rogowski et al. 2018), but they do not occur in the current footprint of Lake Mead. It is unlikely the species would move into the lake since it is primarily a riverine species. However, the only self-sustaining population of razorback sucker exists in Lake Mead, and the fish are reproducing in the upper reservoir near and in the inflows of the Colorado River and Virgin River (Albrecht et al. 2017). The newly hatched larvae shelter in emergent vegetation that is inundated with spring runoff, although predation by nonnative fish is high and survival and recruitment are low (Service 2018b). In the Colorado River inflow, the razorback sucker has been detected where it spawns on cobble shoals in April and May. The flannelmouth sucker is also found in the inflow, but at much lower numbers.

The endangered woundfin and the Virgin River roundtail chub are found in the Virgin River, but they do not occur downstream of Mesquite, Nevada, except when transported from upstream populations by large floods. Therefore, they do not occur within the affected environment and were not further discussed.

Hoover Dam to the SIB

Table 3-25 lists all federally threatened, endangered, or proposed species and whether they occupy the Hoover Dam to the SIB section. **Table 3-26** lists all non-ESA-listed BLM special status species and whether they occupy the Hoover Dam to the SIB section. Species that are not on the BLM sensitive species list but have also been identified as special status species due to their inclusion and coverage under the LCR MSCP (Reclamation 2004a) include the western yellow bat (*Lasiurus xanthinus*), Colorado River cotton rat (*Sigmodon arizonae plenus*), Yuma hispid cotton rat (*Sigmodon hispidus eremicus*), vermilion flycatcher (Pyrocephalus rubinus), Sonoran yellow warbler (*Dendroica petechia sonorana*), and summer tanager (*Piranga rubra*). For habitat requirements of these species, see NatureServe Explorer (2023). Impacts on these species will be captured through the analysis of BLM sensitive species that use the same habitat types in the Hoover Dam to the SIB section.

The endangered razorback sucker and bonytail are introduced from hatchery stocks into Lake Mohave, Lake Havasu, and the reach of river between Parker Dam and Imperial Dam as part of mitigation for the LCR MSCP. They are also stocked into lakeside rearing ponds in Lake Mohave and in created backwaters at Imperial National Wildlife Refuge (NWR). There is some evidence of reproduction by these species, but self-sustaining populations have become established only in the disconnected backwaters of Imperial and Cibola NWRs.

The flannelmouth sucker and bluehead sucker are "conservation species" that are included in a rangewide conservation agreement among six states (Utah Department of Natural Resources 2006). The flannelmouth sucker is found in the riverine reach downstream of Hoover Dam.

Salton Sea

Table 3-25 lists all federally threatened, endangered, or proposed species and whether they occupy the Salton Sea. **Table 3-26** lists all non-ESA-listed BLM special status species and whether they occupy the Salton Sea.

The desert pupfish is a federal and state endangered species. This species tolerates wide temperature fluctuations, low dissolved oxygen, and high salinity (Service 1993). It occurs in nearshore pools of the Salton Sea and irrigation drains to the Salton Sea (Reidel 2016; Service 2010). Surveys conducted by the CDFW between 2003 and 2008 captured a total of four individuals with three in 2004 and one in 2007 in nearshore habitats. However, this species was not captured during surveys in 2017 (CDFW and Service 2017). The desert pupfish occurs in wetland areas downstream of agricultural drains that drain onto the exposed lakebed. The biological opinion for the Salton Sea 10-Year Management Program, issued to the Army Corps on February 23, 2023, provides baseline desert pupfish occurrences in these locations. Razorback sucker was once present in the Salton Sea but was extirpated in the 1920s (Minckley et al. 1991). Additionally, archaeological remains of Colorado pikeminnow and bonytail were found in the ancient Salton Sea (Gobalet and Wake 2000).

3.13.2 Environmental Consequences

Methodology

Analyses in this section rely on the hydrologic modeling presented in **Sections 3.4** and **3.5** as well as models of vegetation impacts produced by Reclamation (2023g) and the US Geological Survey

(USGS) (Butterfield and Palmquist 2023a; 2023b). However, given the lack of comprehensive quantitative modeling results for vegetation impacts across the analysis area, the description of effects of this project on biological resources are largely qualitative.

These analyses also rely on hydrologic modeling for hourly releases from Glen Canyon Dam with the GTMax model run by the Western Area Power Administration (WAPA) and the smallmouth bass model is being developed by the USGS but the results are not available and citable for this SEIS. As with vegetation analyses, fisheries impacts could not be quantitatively determined from relationships of flow to habitat or habitat to fish abundance; rather, the analyses are based on evaluation of the hydrology associated with each alternative and professional scientific assessment.

Similar to the 2007 FEIS, this analysis evaluates the relative difference between the No Action Alternative and the Proposed Action (Reclamation 2007). The level of available information varies with the study sections; therefore, the methodology is adjusted according to the availability of information for a particular section or group of sections. Impacts are only considered through December 2026.

Impact Analysis Area

The impact analysis area for vegetation and terrestrial wildlife is the same as the analysis area used for the 2007 FEIS, which includes the riparian vegetation and aquatic habitat from the northern tip of Lake Powell in Utah south to the SIB (**Map 1-1**; Reclamation 2007). The impact analysis area is divided into five sections: (1) Lake Powell, (2) Glen Canyon Dam to Lake Mead, (3) Lake Mead, (4) Hoover Dam to the SIB, and (5) Salton Sea. Note that the impact analysis area is not synonymous with the area where impacts could occur. The impact analysis area is a broader area intended to ensure all potential impacts are considered. The analysis below includes only species and impacts that would occur as a result of the alternatives analyzed. For example, many of the wildlife species listed as present in the impact analysis area would not actually be affected by the project. See **Appendix G** for information narrowing the species in the impact analysis area to those potentially affected by the alternatives.

The analysis area for fish and aquatic species includes the Colorado River and associated aquatic habitat that is contiguous with the mainstem Colorado River, including the interface with the riparian area, where applicable. The affected environment boundaries are demarcated from the northern tip of Lake Powell in Utah south to the SIB (**Map 1-1**).

Assumptions

Vegetation, Wildlife, and Special Status Species

The vegetation and wildlife and fish assumptions are the same as those described in the 2007 FEIS (Reclamation 2007). Desert scrub plant communities, and the wildlife that rely on these habitat types, would not be affected by operational changes at Glen Canyon and Hoover Dam and are, therefore, not considered in this analysis. Davis Dam and Parker Dam would continue to operate to meet target reservoir elevations, and these operations would remain the same for all alternatives. The biological analysis is dependent upon the data inputs, modeling assumptions, and validity of the hydrology and riparian vegetation models. Impacts on fish species are based on hourly releases from Glen Canyon Dam using the GTMax model runs by WAPA. Dissolved oxygen and temperature of

releases from Glen Canyon Dam are from modeling by the USGS, and information on smallmouth bass is from the smallmouth bass model developed by the USGS.

Impact Indicators

Vegetation

Impacts on vegetation within the analysis area are assessed based on changes in water elevation under the alternatives resulting in changes in vegetation, abundance, general location, and plant community composition. Impact indicators for vegetation remain the same as previously considered for the 2007 FEIS, including hydrologic modeling for the No Action Alternative (Reclamation 2007). Additionally, impacts on vegetation incorporate riparian and backwaters vegetation models provided by Reclamation and the USGS.

Wildlife

Similar to the 2007 FEIS, the analysis of impacts on terrestrial species is based on the vegetation impact analysis. Where impacts are noted for riparian vegetation, impacts are assumed for riparian terrestrial species. Impacts on fish incorporate findings from the 2007 FEIS where the hydrologic analysis was used to inform impacts. Additionally, impacts on the fish community incorporate model results from the GTMax Model and USGS Smallmouth Bass Model, where applicable.

Special Status Species

Similar to the 2007 FEIS, the analysis of impacts on terrestrial special status species are based on the vegetation impact analysis. Where impacts are noted for riparian vegetation, impacts are assumed for riparian special status species. Impacts on fish incorporate findings from the 2007 FEIS where the hydrologic analysis was used to inform impacts. Additionally, impacts on the fish community incorporate model results from the GTMax Model and USGS Smallmouth Bass Model, where applicable.

Issue 1: How would changing flow characteristics affect vegetation?

Summary

Under the No Action Alternative, with no modifications to water management to address worsening drought conditions, water elevations are projected to decrease over time in Lake Powell and Lake Mead to sustain flows in the Glen Canyon Dam to Lake Mead section and the Hoover Dam to the SIB section, resulting in short-term changes to riparian vegetation, including an increase of invasive plant species and loss of suitable habitat for native plant species.

Overall, the types of impacts on riparian vegetation associated with the Proposed Action would be greater than the No Action Alternative;. The No Action Alternative would result in similar impacts on vegetation at Lake Powell and the Glen Canyon Dam to Lake Mead section compared with the Proposed Action until 2025 because the alternatives only vary by Lower Basin system conservation measures and Powell releases below 7.0 maf. From 2025 to 2026, the Proposed Action would result in slightly higher water elevations at Lake Powell. At Lake Powell and Lake Mead, fewer acres of shoreline have the potential to be invaded by nonnative species under the Proposed Action compared with the No Action Alternative. In most scenarios, impacts on riparian vegetation in the Glen Canyon Dam to Lake Mead section and the Hoover Dam to the SIB section would be similar

under the Proposed Action compared with the No Action Alternative until 2026, when water flows are reduced to these sections to maintain higher water elevations in Lake Powell and Lake Mead.

No Action Alternative

Lake Powell

Under the No Action Alternative, the 2007 FEIS and subsequent agreements would continue to guide operations in Lake Powell. With no modifications to water management to address worsening drought conditions, water elevations are projected to decrease over time as water resources become depleted (**Figure 3-5**). **Figure 3-5** displays the median and resulting range of pool elevations that may occur in Lake Powell through 2026 based on CRMMS. In some of the driest potential hydrologic futures (**Section 3.6.2**, **Figure 3-5**), water elevations are projected to decline by approximately 15 to 20 feet from the summer of 2023 through 2026. Beginning in 2026, the drier modeled traces result in pool elevations at Lake Powell that drop below the critical elevation of 3,490 feet but remain above the dead pool elevation of 3,370 feet. Therefore, it is expected that the trends discussed above in **Section 3.13.1** (i.e., increase in acreage of exposed shoreline resulting in increased Russian thistle and tamarisk establishment) would continue under this alternative.

Under the No Action Alternative, the NPS estimates that any additional acreage of exposed shoreline around Lake Powell has the potential to be invaded by invasive plant species such as tamarisk and Russian thistle. An increase in tamarisk establishment would result in increased fire hazard, particularly during drought conditions. In addition, with lower reservoir elevations, cattle and wildlife may be forced to utilize springs and seeps rather than the reservoir for water, causing increased negative impacts such as trampling, spreading of invasive species, and decreased water quality. Very little aquatic vegetation has established at Lake Powell, primarily because of the large (≥10 meters) year-to-year fluctuations in reservoir levels. Thus, aquatic beds of pondweed and shoreline wetlands of emergent vegetation are rare. These wetlands are important to plants and wildlife; if reservoir levels decline further, these wetlands may be further affected (NPS 2023d).

Glen Canyon Dam to Lake Mead

Under the No Action Alternative, the 2007 Interim Guidelines and subsequent agreements would continue to guide operations at Glen Canyon Dam. Beginning in late 2026, releases from Lake Powell under poor hydrologic conditions would reduce water levels at Lake Powell, exposing shoreline. but maintaining similar release levels from Glen Canyon Dam to Lake Mead unless lake levels drop below the critical elevation of 3,490 feet. Therefore, it is expected that the current vegetation conditions, as described above and in the LTEMP FEIS, would persist.

Hydrological niche modeling of 47 common riparian plant species growing on sand bars between Glen Canyon Dam and Diamond Creek at RM225 was conducted for the No Action Alternative (Butterfield and Palmquist 2023a). Separate analyses were conducted within three floristically distinct regions of the Colorado River—Marble Canyon (RM 0–RM 61), eastern Grand Canyon (RM 61–RM 161), and western Grand Canyon (RM 161–RM 226)—and for native and nonnative plant species. The modeling results show projected net changes in suitable habitat for combined native and nonnative species across years (2023–2027) and ESPs (80 percent, 90 percent, and 100 percent), along with projected losses and gains in suitable habitat for each species within each region. For the

100 percent ESP, projected trends for native and nonnative plant species for the period 2024–2027 under the No Action Alternative are as follows:

- Native plant species, as a group, are projected to lose suitable habitat in Marble Canyon (-3.4 percent), eastern Grand Canyon (-0.8 percent), and western Grand Canyon (-0.9 percent). Total change in habitat (from suitable to unsuitable) is projected to be 19.6 percent of the riparian area in Marble Canyon, 18.6 percent of eastern Grand Canyon, and 22.8 percent of western Grand Canyon. Other ESP scenarios have similar patterns.
- Nonnative plant species, as a group, are projected to gain suitable habitat in Marble Canyon (0.4 percent) and lose suitable habitat in eastern Grand Canyon (-4.7 percent) and western Grand Canyon (-6.6 percent). The total change in habitat (either from suitable to unsuitable or vice versa) is projected to be 24.8 percent of the riparian area in Marble Canyon, 16.8 percent of eastern Grand Canyon, and 14.4 percent of western Grand Canyon. Other ESP scenarios have similar patterns.
- Eleven native plant species exhibited overall increases in suitable habitat under these scenarios (no action and 100 percent ESP) in Marble Canyon, while 18 exhibited losses. In eastern Grand Canyon, 15 native species exhibited overall increases, while 15 exhibited losses. In western Grand Canyon, 10 species exhibited increases, while 13 exhibited losses (**Table 3-27**).
- Eight nonnative plant species exhibited overall decreases in suitable habitat under these scenarios (no action and 100 percent ESP) in Marble Canyon, while 4 exhibited increases. In eastern Grand Canyon, 10 nonnative species exhibited overall losses, while 3 exhibited gains. In western Grand Canyon, 7 nonnative species exhibited losses, while 2 exhibited modest or minor gains (**Table 3-28**).

The probabilities of HFEs under the No Action Alternative and Proposed Action are nearly identical. Thus, the No Action Alternative was compared with the Proposed Action with and without HFEs (Butterfield and Palmquist 2023b). The results of this comparative modeling are described below under the Proposed Action.

Table 3-27
Predicted Change in Native Plant Species Habitat Under the No Action Alternative

Species	Predicted Percent Change in Suitable Habitat
Marble Canyon	
Acacia greggii	-20.4
Achnatherum hymenoides	-14.2
Achnatherum speciosum	-8.9
Aristida arizonica	-9.5
Artemisia ludoviciana	68.8
Baccharis emoryi	48.5
Baccharis salicifolia	301.9
Bothriochloa barbinodis	6.1
Brickellia longifolia	-10.2

Species	Predicted Percent Change in Suitable Habitat
Chloracantha spinosa	-2.0
Datura wrightii	7.1
Dicoria canescens	-18.8
Equisetum arvense	-7.4
Euthamia occidentalis	6.7
Fallugia paradoxa	-25.0
Gutierrezia sarothrae	-3.9
Juncus articulatus	5.6
Lepidium fremontii	-3.5
Machaeranthera canescens	7.4
Muhlenbergia asperifolia	31.8
Phragmites australis	-23.3
Pluchea sericea	-8.6
Salix exigua	1.0
Schoenoplectus pungens	3.7
Sporobolus contractus	-14.4
Sporobolus cryptandrus	-0.1
Sporobolus flexuosus	-11.6
Sporobolus gigantea	-11.4
Stephanomeria pauciflora	-14.4
Eastern Grand Canyon	
Acacia greggii	-9.1
Achnatherum hymenoides	-11.4
Aristida arizonica	-6.8
Baccharis emoryi	46.2
Baccharis sarothroides	-8.0
Baccharis salicifolia	51.0
Bouteloua barbata	31.7
Bothriochloa barbinodis	48.2
Chloracantha spinosa	1.0
Datura wrightii	19.4
Dicoria canescens	-28.4
Equisetum arvense	-5.9
Euthamia occidentalis	10.6
Fallugia paradoxa	-43.0
Gutierrezia sarothrae	-3.1
Isocoma acradenia	21.1
Juncus articulatus	3.3
Lepidium fremontii	-4.8
Machaeranthera canescens	2.3
Muhlenbergia asperifolia	7.1
Phragmites australis	-3.7
Pluchea sericea	-6.3
Prosopis glandulosa	7.1

Species	Predicted Percent Change in Suitable Habitat
Salix exigua	0.3
Schoenoplectus pungens	2.5
Sporobolus contractus	-11.0
Sporobolus cryptandrus	0.1
Sporobolus flexuosus	-12.1
Sporobolus gigantea	-9.4
Stephanomeria pauciflora	-17.6
Western Grand Canyon	
Acacia greggii	-15.4
Aristida arizonica	-5.1
Baccharis emoryi	43.8
Baccharis sarothroides	-1.2
Baccharis salicifolia	54.5
Bouteloua barbata	91.3
Bothriochloa barbinodis	288.2
Chloracantha spinosa	11.2
Datura wrightii	3.2
Dicoria canescens	-48.8
Euthamia occidentalis	40.6
Gutierrezia sarothrae	-1.8
Isocoma acradenia	23.4
Juncus articulatus	47.7
Phragmites australis	-7.8
Pluchea sericea	-7.2
Prosopis glandulosa	-3.9
Schoenoplectus pungens	-28.2
Sporobolus contractus	-15.8
Sporobolus cryptandrus	3.1
Sporobolus flexuosus	-24.5
Sporobolus gigantea	-26.5
Stephanomeria pauciflora	-21.5

Source: Butterfield and Palmquist 2023a

Table 3-28
Predicted Change in Nonnative Plant Species Habitat Under the No Action Alternative

Species	Predicted Percent Change in Suitable Habitat
Marble Canyon	
Alhagi maurorum	-30.5
Bromus diandrus	-10.8
Bromus rubens	-9.4
Bromus tectorum	-16.7
Conyza canadensis	25.9
Eragrostis curvula	70.0

Species	Predicted Percent Change in Suitable Habitat
Melilotus officinalis	-5.8
Polypogon viridis	12.8
Salsola tragus	-12.4
Schismus arabicus	-16.7
Schedonorus arundinaceus	11.0
Tamarix sp.	-4.4
Eastern Grand Canyon	
Alhagi maurorum	-13.5
Bromus diandrus	-12.1
Bromus rubens	-8.0
Bromus tectorum	-14.1
Conyza canadensis	11.9
Cynodon dactylon	-6.2
Melilotus officinalis	-9.5
Piptatherum miliaceum	-2.0
Polypogon viridis	9.4
Salsola tragus	-51.4
Schismus arabicus	-14.9
Schedonorus arundinaceus	77.8
Tamarix sp.	-2.5
Western Grand Canyon	
Alhagi maurorum	-9.0
Bromus diandrus	-17.9
Bromus rubens	-10.0
Bromus tectorum	-19.8
Melilotus officinalis	0.1
Piptatherum miliaceum	-0.3
Polypogon viridis	38.3
Schismus arabicus	-18.8
Tamarix sp.	-8.3

Source: Butterfield and Palmquist 2023a

Lake Mead

Under the No Action Alternative, the 2007 Interim Guidelines and subsequent agreements would continue to guide operations in Lake Mead. With no modifications to water management to address worsening drought conditions, water elevations are projected to decrease over time as water resources become depleted (**Figure 3-8**). Water elevations are projected to decline in the summer of 2023 and continue through 2026. Therefore, it is expected that the trends discussed above in **Section 3.11.1** (i.e., encroachment of emergent wetland vegetation, increase in invasive species, etc.) would continue under this alternative.

Hoover Dam to the SIB

Under the No Action Alternative, the 2007 Interim Guidelines and subsequent agreements would continue to guide operations at Hoover Dam. Releases from Lake Mead would remain the same as

existing conditions, depleting Lake Mead but maintaining similar water elevations from Lake Mead to the SIB. Therefore, it is expected that the current vegetation conditions, as described above in **Section 3.11.1** and in the LCR MSCP HCP, would persist. However, with continued drought conditions, as water elevations continue to decline in Lake Powell and the lake drops below minimum power pool elevation and approaches dead pool, less water would be available for release in this reach (**Table 3-29**), at which point riparian habitat may be reduced.

Salton Sea

Under the No Action Alternative, riparian vegetation surrounding the Salton Sea would continue to be influenced by decreasing water levels and increased salinity, resulting in an increase in exposed playa as described above in **Section 3.13.1**.

Proposed Action

Lake Powell

Implementation of the Proposed Action would result in similar water levels in Lake Powell until 2026, when the Proposed Action begins to diverge from the No Action Alternative (**Figure 3-5**). Lake Powell would be maintained at an elevation above 3,500 feet, which is the same as or slightly higher than the No Action Alternative, and by late 2026 the median elevation is projected to be approximately 3,570 feet, which is within the Mid-Elevation Release Tier (see **Section 3.6.2**). Overall, there would be no measurable differences in vegetation from implementation of the Proposed Action compared with the No Action Alternative at Lake Powell.

Glen Canyon Dam to Lake Mead

Hydrological niche modeling for the Proposed Action scenario as it relates to the No Action Alternative shows projected net changes in proportion of native cover, total species richness, and total vegetation cover in 2024 across ESPs (80 percent, 90 percent, and 100 percent), along with projected losses and gains for each metric within each region from 2025 to 2027 (Butterfield and Palmquist 2023b). In general, the riparian vegetation model did not project substantial differences in habitat suitability under the Proposed Action compared with the No Action Alternative. Either with or without HFEs, the small differences in monthly volumes between the No Action Alternative and the Proposed Action had little to no effect on the hydrologic variables that drive habitat suitability for riparian plant species.

Thus, the majority of traces resulted in zero predicted difference in vegetation metrics between the No Action Alternative and Proposed Action scenarios, either with or without HFEs, with one exception. The largest predicted effect of the Proposed Action was a 1.7 percent increase in proportion of native cover in the western Grand Canyon under the driest 10 percent of traces. Overall, the predicted effects of the Proposed Action versus the No Action Alternative on riparian vegetation metrics are negligible (**Table 3-29**, **Table 3-30**, and **Table 3-31**; Butterfield and Palmquist 2023b).

Table 3-29
Projected Change in Native Vegetation Cover under the Proposed Action as Compared with the No Action Alternative

No HFE		Predicted Value in 2024 (Proportion)			Predicted Change					
					Absolute (Proportion)			Relative (%)		
Region	Traces	Mean	95% CI		Mean	95% CI		Mean	95% CI	
Marble Canyon	50-100%	0.79	0.78	0.80	0.00	0.00	0.00	0.0	0.0	0.0
	25-50%	0.79	0.78	0.80	0.00	0.00	0.00	0.0	0.0	0.0
	10-25%	0.79	0.78	0.79	0.00	-0.01	0.00	-0.6	-0.8	-0.4
	0-10%	0.79	0.78	0.79	-0.01	-0.01	0.00	-0.8	-1.0	-0.6
Eastern Grand Canyon	50-100%	0.73	0.71	0.74	0.00	0.00	0.00	0.0	0.0	0.0
	25-50%	0.73	0.71	0.74	0.00	0.00	0.00	0.0	0.0	0.0
	10-25%	0.73	0.72	0.74	0.00	0.00	0.00	0.0	-0.1	0.1
	0-10%	0.73	0.72	0.73	0.00	0.00	0.00	-0.1	-0.2	0.0
Western Grand Canyon	50-100%	0.64	0.62	0.67	0.00	0.00	0.00	0.0	0.0	0.0
	25-50%	0.64	0.62	0.67	0.00	0.00	0.00	0.0	0.0	0.0
	10-25%	0.64	0.63	0.66	0.00	0.00	0.00	-0.3	-0.5	0.0
	0-10%	0.64	0.63	0.65	0.00	0.00	0.00	-0.1	-0.4	0.1

With HFE		Predicted Value in 2024 (Proportion)			Predicted Change					
					Absolute (Proportion)			Relative (%)		
Region	Traces	Mean	95% CI		Mean	95% CI		Mean	95% CI	
Marble Canyon	50-100%	0.68	0.67	0.69	0.00	0.00	0.00	0.0	0.0	0.0
	25-50%	0.68	0.67	0.69	0.00	0.00	0.00	0.0	0.0	0.0
	10-25%	0.68	0.68	0.69	0.00	-0.01	0.00	-0.7	-0.9	-0.5
	0-10%	0.68	0.68	0.69	0.00	-0.01	0.00	-0.6	-0.8	-0.5
Eastern Grand Canyon	50-100%	0.58	0.56	0.60	0.00	0.00	0.00	0.0	0.0	0.0
	25-50%	0.58	0.56	0.60	0.00	0.00	0.00	0.0	0.0	0.0
	10-25%	0.58	0.57	0.59	0.00	0.00	0.01	0.6	0.3	1.0
	0-10%	0.58	0.57	0.59	0.00	0.00	0.01	0.8	0.5	1.1
Western Grand Canyon	50-100%	0.47	0.46	0.47	0.00	0.00	0.00	0.0	0.0	0.0
	25-50%	0.47	0.46	0.47	0.00	0.00	0.00	0.0	0.0	0.0
	10-25%	0.47	0.46	0.47	0.00	0.00	0.00	0.4	-0.1	0.9
	0-10%	0.47	0.46	0.47	0.00	0.00	0.01	1.0	0.4	1.7

Source: Butterfield and Palmquist 2023b

Note: Predicted net change in proportion native cover, calculated as the difference between cumulative habitat gains and losses, comparing the Proposed Action with the No Action Alternative, with or without HFEs, across all sandbars and years (2025–2027). Suitable habitat totals under the No Action Alternative scenario in 2024 were used to calculate the relative (percentage) change values. Different trace classes represent the lowest (0 to 10 percent) to the highest (50 to 100 percent) lake level quantiles.

Table 3-30
Projected Change in Species Richness under the Proposed Action as Compared with the No Action Alternative

No HFE		Predicted Value in 2024 (Species per Sandbar)			Predicted Change					
					Absolute (Species)			Relative (%)		
Region	Traces	Mean	95% CI		Mean	95% CI		Mean	95% CI	
Marble Canyon	50-100%	34.68	33.77	35.60	0.00	0.00	0.00	0.0	0.0	0.0
	25-50%	34.68	33.77	35.60	0.00	0.00	0.00	0.0	0.0	0.0
	10-25%	34.68	34.10	35.27	0.05	-0.01	0.10	0.1	0.0	0.3
	0-10%	34.68	34.29	35.08	-0.04	-0.09	0.01	-0.1	-0.3	0.0
Eastern Grand Canyon	50-100%	31.69	31.10	32.29	0.00	0.00	0.00	0.0	0.0	0.0
	25-50%	31.69	31.10	32.29	0.00	0.00	0.00	0.0	0.0	0.0
	10-25%	31.69	31.31	32.07	-0.02	-0.11	0.07	-0.1	-0.4	0.2
	0-10%	31.69	31.44	31.95	-0.14	-0.22	-0.05	-0.4	-0.7	-0.1
Western Grand Canyon	50-100%	21.38	19.98	22.77	0.00	0.00	0.00	0.0	0.0	0.0
	25-50%	21.38	19.98	22.77	0.00	0.00	0.00	0.0	0.0	0.0
	10-25%	21.38	20.50	22.25	0.07	-0.02	0.16	0.3	-0.1	0.8
	0-10%	21.38	20.79	21.96	-0.02	-0.09	0.06	-0.1	-0.4	0.3

With HFE		Predicted Value in 2024 (Species per Sandbar)			Predicted Change					
					Absolute (Species)			Relative (%)		
Region	Traces	Mean	95% CI		Mean	95% CI		Mean	95% CI	
Marble Canyon	50-100%	32.58	32.14	33.02	0.00	0.00	0.00	0.0	0.0	0.0
	25-50%	32.58	32.14	33.02	0.00	0.00	0.00	0.0	0.0	0.0
	10-25%	32.58	32.29	32.86	0.05	-0.01	0.11	0.2	0.0	0.3
	0-10%	32.58	32.38	32.77	0.03	-0.01	0.07	0.1	0.0	0.2
Eastern Grand Canyon	50-100%	30.54	29.93	31.15	0.00	0.00	0.00	0.0	0.0	0.0
	25-50%	30.54	29.93	31.15	0.00	0.00	0.00	0.0	0.0	0.0
	10-25%	30.54	30.14	30.93	-0.08	-0.15	-0.01	-0.3	-0.5	0.0
	0-10%	30.54	30.27	30.81	-0.13	-0.19	-0.06	-0.4	-0.6	-0.2
Western Grand Canyon	50-100%	21.13	20.29	21.96	0.00	0.00	0.00	0.0	0.0	0.0
	25-50%	21.13	20.29	21.96	0.00	0.00	0.00	0.0	0.0	0.0
	10-25%	21.13	20.59	21.66	0.08	-0.04	0.21	0.4	-0.2	1.0
	0-10%	21.13	20.76	21.49	0.05	-0.02	0.11	0.2	-0.1	0.5

Source: Butterfield and Palmquist 2023b

Note: Predicted net change in species richness, calculated as the difference between species gains and losses, comparing the Proposed Action to the No Action Alternative scenario, with or without HFEs, across all sandbars and years (2025–2027). Suitable habitat totals under the No Action Alternative scenario in 2024 were used to calculate the relative (percentage) change values. Different trace classes represent the lowest (0 to 10 percent) to the highest (50 to 100 percent) lake level quantiles.

Table 3-31
Projected Change in Total Vegetation Cover under the Proposed Action as Compared with the No Action Alternative

No HFE		Predicted Value in 2024 ($10^5 m^2$)			Predicted Change					
					Absolute ($10^3 m^2$)			Relative (%)		
Region	Traces	Mean	95% CI		Mean	95% CI		Mean	95% CI	
Marble Canyon	50-100%	11.27	8.77	13.77	0.00	0.00	0.00	0.0	0.0	0.0
	25-50%	11.27	8.77	13.77	0.00	0.00	0.00	0.0	0.0	0.0
	10-25%	11.27	9.66	12.87	-1.84	-5.61	1.92	-0.2	-0.5	0.2
	0-10%	11.27	10.18	12.36	-5.22	-8.83	-1.61	-0.5	-0.8	-0.1
Eastern Grand Canyon	50-100%	6.03	4.41	7.64	0.00	0.00	0.00	0.0	0.0	0.0
	25-50%	6.03	4.41	7.64	0.00	0.00	0.00	0.0	0.0	0.0
	10-25%	6.03	5.00	7.06	-0.79	-3.07	1.50	-0.1	-0.5	0.2
	0-10%	6.03	5.33	6.72	-2.90	-5.30	-0.50	-0.5	-0.9	-0.1
Western Grand Canyon	50-100%	5.70	4.19	7.21	0.00	0.00	0.00	0.0	0.0	0.0
	25-50%	5.70	4.19	7.21	0.00	0.00	0.00	0.0	0.0	0.0
	10-25%	5.70	4.76	6.65	-0.95	-3.41	1.52	-0.2	-0.6	0.3
	0-10%	5.70	5.07	6.34	-3.05	-6.49	0.39	-0.5	-1.1	0.1

With HFE		Predicted Value in 2024 ($10^5 m^2$)			Predicted Change					
					Absolute ($10^3 m^2$)			Relative (%)		
Region	Traces	Mean	95% CI		Mean	95% CI		Mean	95% CI	
Marble Canyon	50-100%	9.35	8.18	10.53	0.00	0.00	0.00	0.0	0.0	0.0
	25-50%	9.35	8.18	10.53	0.00	0.00	0.00	0.0	0.0	0.0
	10-25%	9.35	8.59	10.12	1.97	0.08	3.87	0.2	0.0	0.4
	0-10%	9.35	8.83	9.87	0.95	-0.61	2.50	0.1	-0.1	0.3
Eastern Grand Canyon	50-100%	5.37	4.45	6.28	0.00	0.00	0.00	0.0	0.0	0.0
	25-50%	5.37	4.45	6.28	0.00	0.00	0.00	0.0	0.0	0.0
	10-25%	5.37	4.77	5.96	-0.14	-1.35	1.08	0.0	-0.3	0.2
	0-10%	5.37	4.96	5.77	-1.13	-2.59	0.34	-0.2	-0.5	0.1
Western Grand Canyon	50-100%	4.91	4.15	5.66	0.00	0.00	0.00	0.0	0.0	0.0
	25-50%	4.91	4.15	5.66	0.00	0.00	0.00	0.0	0.0	0.0
	10-25%	4.91	4.42	5.39	-1.84	-4.85	1.18	-0.4	-1.0	0.2
	0-10%	4.91	4.57	5.24	-2.43	-4.65	-0.21	-0.5	-0.9	0.0

Source: Butterfield and Palmquist 2023b

Note: Predicted net change in suitable habitat for vegetation, calculated as the difference between cumulative habitat gains and losses, comparing the Proposed Action with the No Action Alternative scenario, with or without HFEs, across all sandbars and years (2025–2027). Suitable habitat totals under the No Action Alternative scenario in 2024 were used to calculate the relative (percentage) change values. Different trace classes represent the lowest (0 to 10 percent) to the highest (50 to 100 percent) lake level quantiles.

Lake Mead

Implementation of the Proposed Action would cause an initial decrease in the elevation of Lake Mead followed by a steady increase starting in mid-2024. By the end of 2026, the median elevation is projected to be approximately 1,055 feet, which is still within shortage conditions. Overall, more

water would be preserved in Lake Mead under this alternative compared with the No Action Alternative and impacts on vegetation would be similar to those described for Lake Powell. However, these impacts would be less pronounced at Lake Mead due to differences in geomorphology and because the projected difference in the lake elevation for the Proposed Action compared with the No Action Alternative is smaller than that at Lake Powell.

Hoover Dam to the SIB

In general, impacts on vegetation within this stretch from implementation of the Proposed Action would be greater than impacts from the No Action alternative. Modeling using Reclamation's 2000 backwater mapping was conducted to determine potential changes in marshes/backwater emergent vegetation under this alternative using the methodology described in Appendixes J and K of the LCR MSCP HCP. The model showed that with an increase in flow reduction from Hoover Dam, there would be a corresponding short-term increase in impacts on backwater emergent wetland vegetation and open-water areas of backwaters and marsh lands due to the changes in flow over the 3-year period of analysis in this SEIS.

Salton Sea

According to the updated Salton Sea Accounting Model (SSAM) and projections of future IID water delivery using Reclamations CRSS model, the Proposed Action would cause a decrease in water level and a corresponding increase in exposed playa beginning in late 2025/early 2026 as compared with the No Action Alternative. An increase in exposed playa would result in an increased risk for the establishment of invasive species along with an increase in fugitive dust, which could have a detrimental effect on the productivity of adjacent vegetation. However, water levels would stabilize by 2040 and would be similar to the No Action Alternative (TetraTech 2023).

Cumulative Effects

If one of the LTEMP SEIS flow options were implemented, it would not have a measurable effect on vegetation. Generally, all other actions that could result in cumulative impacts on vegetation have been incorporated into the modeling of future system conditions and described under the affected environment in **Section 3.11.1**. Therefore, no cumulative effects on vegetation are anticipated.

Issue 2: How would changing flow characteristics affect wildlife?

Riparian habitat is common along the banks of the Colorado River, and the vegetation community in this area is most affected by changes in flow characteristics. Many wildlife species that utilize the analysis area are habitat generalists that use a combination of upland and riparian habitat (Reclamation and NPS 2016). These species are less susceptible to changes in riparian habitat availability. However, some species are obligate riparian species, relying on riparian habitat for all stages of their life cycle. These species can be sensitive to changes in habitat availability (Reclamation and NPS 2016). Species that utilize riparian habitat are discussed further below.

Numerous upland wildlife species that do not rely on riparian vegetation are found within the analysis area. Consistent with the analysis in the 2007 FEIS, no impacts of these alternatives are expected to these species (Reclamation 2007). Therefore, these species are not discussed further in this analysis.

Native and nonnative fish are sensitive to changes in flow, and flow can be a tool used to manage the species. Reduced flows may impact fish species depending on the developmental phase or life history. Furthermore, volumes of discharge and lake elevations also affect water temperatures, which can affect fish species. For example, a reduction of release volumes through the dam could reduce available lacustrine habitat while increasing riverine habitat. Impacts from reduced flows on habitat availability were evaluated on a reach-specific basis.

Summary

The impacts associated with each alternative are similar because they vary only by Lower Basin system conservation measures and Lake Powell annual releases below 7.0 maf. The No Action Alternative would result in similar impacts on terrestrial wildlife at the Lake Powell, Glen Canyon Dam to Lake Mead, and Salton Sea sections compared with the Proposed Action until 2025. From 2025 to 2026, the Proposed Action would have higher elevations, resulting in reduced impacts on terrestrial wildlife, although the differences in impacts are likely to be minor.

In the driest years, the reduced elevation of Lake Powell would slightly increase the length of the new river channels carved from deltaic deposits in both the Colorado River and San Juan River inflows, resulting in a slight increase of riverine habitat. The elevation of Lake Powell is not expected to increase enough to prevent the waterfall in the San Juan River inflow from remaining a barrier to upstream fish movement. Under the No Action Alternative, the elevation of Lake Powell could reach a high level of 3,660 feet (see **Figure 3-5**) in 2024, which would allow fish to move upstream into the San Juan River.

The major reproducing population of humpback chub was historically located in the Little Colorado River, but an extension of the greater Grand Canyon population has recently occurred between Havasu Creek and Pearce Ferry (western Grand Canyon) and is currently the largest reproducing population in the canyon. Reduced releases could result in less low-velocity habitat along talus shorelines and in backwaters for young fishes. In the Colorado River mainstem, backwaters are ephemeral habitats. Warmer temperatures would lead to faster growth of humpback chub and other native fishes. However, warmer temperatures are beneficial for nonnative fishes such as smallmouth bass, which could become established if additional actions are not taken. Impacts on terrestrial wildlife at Lake Mead and Hoover Dam to the SIB would be slightly higher under the No Action Alternative compared with the Proposed Action. However, the differences in impacts are likely to be minor. Water reduction from Hoover Dam to the SIB would reduce the extent and connectivity of available backwater habitat used by razorback sucker and bonytail. Survival of razorback sucker in this reach is low, and recruitment is nonexistent. The No Action Alternative and Proposed Action are not expected to substantially change those demographics. There is low survival and no recruitment of bonytail, and the No Action Alternative and Proposed Action are not expected to change those demographics.

Water elevations are predicted to be lower under the Proposed Action for the Salton Sea, exacerbating existing issues of water availability and salinity for migratory birds and terrestrial wildlife. Rivers that inflow into the Salton Sea include the New River, Alamo River, and Whitewater River. Tilapia is likely the only species present in Salton Sea, as they were the only species captured in the most recent surveys in 2017 (CDFW and Service 2017). Reductions in flow and increased

salinity may reduce habitat for tilapia. There are previous accounts of desert pupfish in 2004 and 2007 from CDFW surveys of the Salton Sea, and it is possible but unlikely that this species is still present in the Salton Sea. If desert pupfish are present, they are likely in small numbers in and near irrigation returns and it is not likely that the alternatives will be detrimental to the persistence of this species. Reduction in water and increase in salinity could potentially change habitat distribution of this species; however, this species has high tolerances of water quality changes and can move to suitable habitat where available. Mozambique tilapia are tolerant of salinities up to 65 parts per thousand (ppt, or grams/liter) (Sartella et al 2004). However, salinity in the Salton Sea is currently at approximately 75 ppt and is expected to increase to approximately 87 ppt by the year 2025 (see **Figure 3-32**). As a consequence of increased salinity, tilapia are expected to retreat to inflow areas where salinity is lower. Cellular necrosis of tilapia occurred at 95 g/L (Sartella et al 2004), and salinity may exceed that by the year 2027. Desert pupfish salinity tolerance is 68 g/L (Service 1993). Based on increased salinity, the Salton Sea will become increasingly less tolerable to even the most saline-tolerant freshwater species such as tilapia and desert pupfish.

No Action Alternative

Lake Powell

In some of the driest potential hydrologic futures (**Section 3.6.2**, **Figure 3-5**), water elevations are projected to decline in summer 2023 and continue to decline through 2026.

Reduced water elevation would alter riparian vegetation, with increased invasive vegetation colonizing newly exposed sediments (see vegetation section), thus impacting terrestrial wildlife species that utilize riparian habitat. In this portion of the analysis area, riparian habitat is a limited resource because desert terrain extends directly to the water's edge and the lake elevation is continuously fluctuating (Reclamation 2007). Lake elevations would continue to fluctuate under the No Action Alternative; therefore, impacts on terrestrial wildlife would be similar to those described in the 2007 FEIS (Reclamation 2007), with an increasing magnitude of effects as reservoir elevations decrease.

If reduced water availability, declining lake levels, and reduced available flows for release continue, there are likely multiple potential outcomes for aquatic species. The low lake levels have already exposed deltaic deposits and carved new channels in the Colorado River and San Juan River. Declining lake levels would likely continue to expand or increase riverine habitat, which would benefit riverine species in the inflows to Lake Powell, specifically razorback sucker and possibly Colorado pikeminnow.

Glen Canyon Dam to Lake Mead

If water elevations of Lake Powell continue to decline and hydrologic conditions do not provide sufficient moisture, less water will be available for release through Glen Canyon Dam. Riparian vegetation along this stretch would be affected as water levels dropped. Some vegetation in the current riparian zone would be expected to die, while new vegetation would colonize the lower riparian zone. The timing of this transition is unknown but may begin by 2026. During this transitional period, there could be impacts on species that utilize riparian habitat (Butterfield and Palmquist 2023c; Holm et al. 2023).

There are several species of nonnative fish (Valdez and Carothers 1998) that have been detected in the Colorado River below Glen Canyon Dam through the Grand Canyon; however, most of them are not established as self-sustaining populations. The fish community is predominantly composed of native species. The lowered lake elevation and reduction in water volumes through Glen Canyon Dam would result in increased water temperatures that would benefit native species such as humpback chub, which experience increased growth rates with warmer temperatures. However, it could also benefit nonnative fish species such as smallmouth bass, common carp, channel catfish, bullheads, green sunfish, fathead minnows, and red shiners, which could lead to increased predation and competition on native fish. Adult and large subadult smallmouth bass have been found in small numbers prior to 2022 in the Lees Ferry reach, near the Little Colorado River, and near Diamond Creek. These fish likely originated from passage through Glen Canyon Dam, moving down from reservoirs in the Little Colorado River, and movement upstream from Lake Mead, respectively. Young smallmouth bass have been found in 2022 and 2023, indicating local reproduction as a consequence of warmer releases from Glen Canyon Dam. Under No Action, this invasion of smallmouth bass is likely to continue and likely to impose an increased predation threat on native and listed fish species.

Species such as rainbow trout and brown trout prefer colder water, and the warmer water temperatures would provide less suitable conditions for especially the former species. A reduction in water released through Glen Canyon Dam may increase the river's water clarity, allowing sight predators, such as rainbow trout and brown trout, to more efficiently prey on native fish (Ward et al. 2016). However, these trout species are also less efficient swimmers when water temperatures are warmer, whereas warmwater native species—such as humpback chub, razorback sucker, and flannelmouth sucker—experience improved efficiency with warmer temperatures (Valdez and Carothers 1998). With increased temperatures (above 18°C), parasites such as Asian tapeworm (*Bothriocephalus acheilognathi*) and anchorworms (*Lernaea cyprinacea*) may increase. The Asian tapeworm can block the intestine of fish and lead to death, and anchorworm can cause infections on attachment points on the body and fins.

Sandbars that form as reattachment bars associated with large, recirculating eddies form recurrent channels that are backwaters used by native fish in the Colorado River through the Grand Canyon. At certain flow ranges, these backwaters are used extensively by young humpback chub and flannelmouth suckers. These backwaters provide warm, sheltered habitats for these fish and are important habitats for improved survival and recruitment of native fish (Dodrill et al. 2014). These backwaters may be affected by different releases from Glen Canyon Dam, as low releases may desiccate these habitats and high releases may inundate them. However, backwaters are rare and ephemeral habitats, so they contain only a small portion of the overall population. Under the No Action, there may be an impact to backwaters; however, the use of backwater habitat is likely not a required habitat type for native fish habitat persistence.

There could be both positive and negative effects on fish populations downstream of Glen Canyon Dam when the temperature of the water released shifts from warmwater to cold water if releases have to be made through the bypass valves. This colder release could temporarily shock juvenile and adult rainbow trout in the Lees Ferry reach (although they are a coldwater fish) as well as eggs and

fry that would be in the gravel beds at that time. Coldwater releases could inhibit spawning of smallmouth bass and other warmwater nonnatives.

Lake Mead

Riparian habitat around Lake Mead is temporary because of fluctuating lake elevations. Lake elevations would continue to fluctuate under the No Action Alternative; therefore, impacts on terrestrial wildlife would be similar to those described in the 2007 FEIS (Reclamation 2007), with an increasing magnitude of effects as water elevations decrease. In areas where new sediments are exposed, larger animals may become stuck in deep mud and die. This is currently occurring and may be exacerbated with declining lake levels under this alternative.

The No Action Alternative may improve and increase habitat for nonnative fish that prey upon native species because of lower lake levels and warmer water releases to the Colorado River below GCD. Additionally, reduced lake levels may reduce the amount of available habitat for forage fish that are used to support the nonnative fishery for sportfish in the lake. Like Lake Powell, Lake Mead has a large variety of nonnative fish species that are valuable as sport fish and as forage fish. Reductions in lake levels would not have as extensive an effect on shoreline spawners as in Lake Powell because the shoreline of Lake Mead is gentle and sloping with cobble shoals that extend at a variety of lake levels. Reduced lake levels will also maintain or slightly extend the length of the river channel in the Colorado River inflow that has been recently populated by a new and large population of humpback chub. Lower lake levels are not likely to affect the razorback sucker, as spawning habitat (talus/cobble shoreline) and nursery habitat (emergent vegetation) are available through a range of lake elevations.

Both Lake Mead and Lake Mohave have experienced algal blooms since the early 2000s. These blooms are the result of nutrients within the Colorado River generally derived from decaying vegetation in the largely undeveloped watershed, as well as nutrients from the Virgin River, Muddy River, and Las Vegas Wash. These nutrients arrive in the form of treated wastewater, urban runoff, and agricultural runoff. Lower lake levels affect lake nutrients as well as nutrient dynamics. These in turn affect the amounts and location of algae produced in these reservoirs. Starting in the year 2000, the wastewater treatment plants along Las Vegas Wash have enhanced their phosphorus removal, improving water quality and reducing the potential for algal blooms. Monitoring has revealed that these blooms include blue-green algae, which bloomed in large amounts in 2011–2015 and again in recent years since 2020. Blue-green algae produces a toxin called microcystin that can cause health issues in people and wildlife. The effects of these algal blooms on fish and wildlife are not well understood, and monitoring will need to be continued to better understand the relationship between reservoir elevations, algal blooms, and effects on fish populations in Lakes Mead and Mohave.

Hoover Dam to the SIB

Under the No Action Alternative, the 2007 Interim Guidelines and subsequent agreements would continue to guide operations at Hoover Dam. Releases from Lake Mead would remain the same as existing conditions, depleting Lake Mead but maintaining similar water elevations from Hoover Dam to the SIB. Impacts on riparian vegetation and terrestrial wildlife species would, therefore, be similar to those described in the 2007 FEIS (Reclamation 2007).

Under the No Action Alternative, flows would be lower but no substantive effects to water quality would be expected. However, lower flows may affect the connectivity and extent of backwaters. Overall, reductions in water availability would have the same impacts on native fish through reduction of habitat such as backwater and floodplains. Reduced flows and increased water temperatures may also improve suitable habitat for nonnative fish such as flathead catfish and channel catfish, thereby also increasing the potential for predation on native species. Warmer water temperature may allow for expansion of flathead catfish particularly in riverine and riverside habitats of the lower basin, but this species is not likely to move upstream into other regions.

Even in some of the driest potential hydrologic futures (**Section 3.6.2**, **Figure 3-8**), Lake Mead does not hit dead pool. Therefore, water is projected to be available to be released downstream through 2026.

Salton Sea

SALSA and SSAM predict a decline in lake levels at the Salton Sea through 2026 under the No Action Alternative, which would reduce aquatic habitat availability as well as increase salinity. Decreased aquatic habitat and increased salinity could impact terrestrial wildlife through decreases in aquatic food supply.

The Salton Sea is an important migratory stopover site for birds, and a decrease in food supply could result in impacts on large numbers of migratory waterbirds on the West Coast. An increase in exposed playa could result in an increased risk for the establishment of invasive species, thereby reducing habitat quality for terrestrial wildlife species along the shoreline.

Water elevations have been dropping at the Salton Sea, and salinity has been rising past the point of submergent vegetation tolerance for several years. While the No Action Alternative may exacerbate this problem, ongoing issues with Salton Sea water elevations and salinity are the main driver of impacts on terrestrial wildlife in this section (Imperial Irrigation District 2018a).

Based on the fisheries surveys of the Salton Sea conducted by CDFW between 2003 and 2008, most fish species were tilapia with small numbers of other species, including four desert pupfish. No desert pupfish were captured in 2017; tilapia were the only species captured. Under the No Action Alternative, a reduction in water and an increase in salinity could potentially reduce lacustrine habitat for tilapia. As desert pupfish utilize nearshore pools, this could also reduce habitat for this species; however, this species has not been recently documented in the Salton Sea. If desert pupfish are still present, it is likely this species will not be largely affected because it can move into other nearshore pools where habitat is suitable. As long as freshwater inflows do not cease, it is likely that impacts under the No Action Alternative will not be detrimental to the fish that currently occupy the Salton Sea.

Proposed Action

Lake Powell

Overall, the Proposed Action maintains similar water levels to the No Action Alternative in Lake Powell until late 2025, when the Proposed Action begins to diverge from the No Action Alternative. More water is available in Lake Powell under the Proposed Action. Therefore, the magnitude of

effects would be greater under the No Action Alternative. However, impacts on vegetation are predicted to be the same between the two alternatives (**Section 3.13.2**, **Issue 1**). Given that the predicted elevations and vegetation models are only marginally different, no population level impacts are expected on terrestrial wildlife.

Under certain hydrologic scenarios, the Proposed Action could negatively impact the nonnative sport fish in the lake. As lake elevations change, available shoreline habitat also changes, affecting sport fish populations. When lake elevations are higher, the length of riverine habitat associated with the inflow into Lake Powell would be reduced compared with scenarios where lake elevation is reduced. The lake level fluctuates annually, however, and it is unlikely to have a significant impact on habitat to affect the species.

Glen Canyon Dam to Lake Mead

If the Proposed Action is implemented, releases from Lake Powell would be similar to the No Action Alternative through late 2025, at which point releases would be lower than the No Action Alternative to 2026, which would result in lower river flows in this section. Therefore, the magnitude of effects would be greater under the Proposed Action. However, the riparian vegetation model projects similar native plant species cover and richness under the Proposed Action compared with the No Action Alternative in all modeled areas. Nonnative plant species cover and richness is projected to be similar under the Proposed Action compared with the No Action Alternative. Compared with native species, nonnative plant species typically provide lower-quality habitat for wildlife species and can lead to monotypic habitat types that support fewer wildlife species (NatureServe 2023). Given the predicted flows and vegetation models are only marginally different, no population level impacts are expected on terrestrial wildlife.

Impacts on the invertebrate and algal communities in the Lees Ferry reach are not expected to differ greatly between No Action and the Proposed Action. Higher dam releases under the Proposed Action are expected to maintain a greater wetted area in peripheral habitats that will maintain more robust invertebrate and algal communities. The impacts would differ depending on whether a fall (October–November) or spring (March–April) HFE was implemented. Fall HFEs can scour the benthic community at a time that is characterized by low sun angle and low photosynthetic productivity that can limit benthic recovery. Spring HFEs occur at a time of increasing photosynthetic activity that can help the benthos recovery more quickly. Because of low hydrology conditions in the Colorado River system, the likelihood of HFEs is lower.

Adult and large subadult smallmouth bass have been found in small numbers prior to 2022 in the Lees Ferry reach, near the Little Colorado River, and near Diamond Creek. These fish likely originated from passage through Glen Canyon Dam, moving down from reservoirs in the Little Colorado River, and movement upstream from Lake Mead, respectively. Young smallmouth bass have been found in 2022 and 2023, indicating local reproduction as a consequence of warmer releases from Glen Canyon Dam. Under the Proposed Action, this invasion of smallmouth bass may be somewhat abated by management actions, but is likely to continue and likely to impose an increased predation threat on native and listed fish species.

Lake Mead

Overall, the Proposed Action maintains higher water levels compared to the No Action Alternative in Lake Mead. Therefore, the magnitude of effects would be greater under the No Action Alternative. Riparian habitat around Lake Mead is temporary because of fluctuating lake elevations.. Given that the predicted elevations are only marginally different, no population level impacts are expected on terrestrial wildlife. Impacts associated with wildlife becoming trapped in soft sediments would be less likely under the Proposed Action compared with the No Action Alternative, as fewer sediments would be exposed.

Reduction of lake elevation is expected to occur at a lesser rate than the No Action Alternative under the 80 percent ESP until approximately August 2025. This would likely improve and increase habitat for nonnative fish. Additionally, reduced lake levels may reduce the amount of available habitat for forage fish that are used to support the nonnative fishery for sport fish in the lake. Following August 2025, this reduction would lessen and result in increased lake elevations compared with the No Action Alternative.

The Proposed Action would help to stabilize the elevation of Lake Mead and therefore continue to provide extended riverine habitat for the humpback chub in the Colorado River inflow. This area could also provide suitable habitat for the razorback sucker. Stabilized lake elevation would also provide more stable spawning habitat for razorback sucker and a greater likelihood of emergent vegetation as cover for larvae, which could increase survival and recruitment.

Hoover Dam to the SIB

Releases from Lake Mead would be reduced to maintain higher elevations in Lake Mead, reducing water elevations from Hoover Dam to the SIB. Impacts on riparian vegetation and terrestrial wildlife species would, therefore, be greater under the Proposed Action than the No Action Alternative. Reduced flows resulting from the Proposed Action would result in lower river stage in this section, which could have impacts on emergent marsh vegetation. This may cause direct loss of vegetation through desiccation and the fragmentation or reduction in the extent of habitat patches. Therefore, the magnitude of effects would be greater under the Proposed Action (**Section 3.6.2**, **Figure 3-8**). However, given that the predicted flows are only marginally different, no population level impacts are expected on terrestrial wildlife species.

The fish community is dominated by nonnative fish, and the lower river flows in this reach under the Proposed Action would result in improved habitat for nonnative species, continued pressure on native species, and potentially more interactions between nonnative and native species. Lower river flows may also provide opportunities for range expansion of nonnative fishes such as flathead catfish and other warm water nonnative fishes. Backwater habitats that currently occur in this reach and support stocked populations of razorback sucker and bonytail will be reduced in habitat area, and possibly connectivity, under the Proposed Action as compared with the No Action Alternative. Of particular concern is reduced area of the Cibola NWR backwater that supports a self-sustaining population of bonytail, as the water elevation and water quality of this backwater is dependent on river flows.

Salton Sea

According to the updated SSAM and projections of future IID water delivery using Reclamation's CRSS model, the Proposed Action would expedite previously anticipated decreases in water level and corresponding increases in exposed playa at the Salton Sea beginning in 2024 as compared with the No Action Alternative, worsening existing issues of water availability and salinity for terrestrial wildlife (Imperial Irrigation District 2018a). However, given that the predicted flows are only marginally different, no population level impacts are expected on terrestrial wildlife species. Similarly, impacts on fisheries are also predicted to be the same between the two alternatives.

Cumulative Effects

One of the stated purposes of the Salton Sea Management Program's 10-Year Plan is to improve habitat for fish and wildlife through mitigating effects of decreasing water levels and increased salinity in recent years (California Natural Resources Agency 2021). The construction of ponds and aquatic habitat to support fish and wildlife is intended to restore habitat at appropriate salinity levels to support fish and wildlife. This will result in a positive impact on terrestrial wildlife species.

Reclamation's Upper Colorado Basin Region is preparing an SEIS to the LTEMP regarding experimental operations at the Glen Canyon Dam that will analyze flow options from Glen Canyon Dam to prevent smallmouth bass from establishing below the dam by preventing additional spawning. If one of the flow options from the LTEMP SEIS were to be implemented, this action would cumulatively impact aquatic species within the Colorado River below Glen Canyon Dam to Lake Mead due to a reduction in the temperature of water released. The intent of this potential action is to disrupt spawning of smallmouth bass by releasing cold water through the river outlets to move smallmouth bass off nests or prevent them from spawning. Smallmouth bass are adept predators with wide diet variability, and this change may impact native fish (Bestgen and Hill 2016). Changes to the timing and frequency of HFEs resulting from the potential change to sediment accounting windows was previously analyzed in LTEMP. Any cumulative effects of these changes would fall within the previously analyzed range.

Issue 3: How would changing flow characteristics affect special status species?

Numerous upland special status species are found within the analysis area that neither rely on riparian vegetation nor grow in riparian habitat. Consistent with the finding of the 2007 FEIS analysis, no impacts of the alternatives analyzed in this SEIS are expected on these species (Reclamation 2007). A complete list of all special status species from **Table 3-32** and **Table 3-33** not analyzed in detail, and their habitat needs, is included in **Appendix G**.

The analysis below provides a table of those species evaluated for impacts within each section (Lake Powell, Glen Canyon Dam to Lake Mead, Lake Mead, Hoover Dam to the SIB, and the Salton Sea). The following analysis addresses only those species found in each section with habitat that could be affected by proposed operations within the analysis time frame through December 2026.

Table 3-32
Special Status Species with Records at Lake Powell and Potential Habitat Impacts Under the No Action Alternative

Common Name	Scientific Name	Status	Potential Impacts
Bonytail chub	Gila elegans	Endangered BLM NV	Changes to water levels, impacting spawning and nursery habitat, possible adverse health impacts from algal blooms and dissolved oxygen changes in Lake Mohave due to increased temperatures and a decrease in the range of flow fluctuations
Colorado pikeminnow	*Ptychocheilus lucius*	Endangered	Habitat expansion due to declining lake levels as result of increased riverine habitat
Razorback sucker	*Xyrauchen texanus*	Endangered	Habitat expansion due to declining lake levels as result of increased riverine habitat
Flannelmouth sucker	*Catostomus latipinnis*	BLM AZ BLM UT	Habitat expansion due to declining lake levels as result of increased riverine habitat
American white pelican	*Pelecanus erythrorhynchos*	BLM UT	Changes to open-water habitat availability, impacting foraging habitat
Bald eagle	*Haliaeetus leucocephalus*	BLM AZ BLM NV BLM UT	Changes to water levels, impacting foraging habitat
California condor	*Gymnogyps californianus*	BLM AZ	Changes to water levels potentially increasing scavenging opportunities
Golden eagle	*Aquila chrysaetos*	BLM UT BLM AZ	Changes to water levels potentially increasing scavenging opportunities
Lucy's warbler	*Leiothlypis luciae*	BLM CA	Changes to water levels, impacting foraging and nesting habitat
Allen's big-eared bat	*Idionycteris* (=*Plecotus*) *phyllotis*	BLM AZ BLM NV BLM UT	Changes to riparian habitat availability, impacting foraging habitat
Big brown bat	*Eptesicus fuscus*	BLM NV	Changes to riparian habitat availability, impacting foraging habitat
California myotis	*Myotis californicus*	BLM NV	Changes to riparian habitat availability, impacting foraging habitat
Canyon bat	*Parastrellus hesperus*	BLM NV	Changes to riparian habitat availability, impacting foraging habitat

Common Name	Scientific Name	Status	Potential Impacts
Cave myotis	*Myotis velifer*	BLM AZ BLM NV	Changes to riparian habitat availability, impacting foraging habitat
Desert bighorn sheep	Ovis canadensis nelsoni	BLM CA	Exposed soft sediments trapping individuals and causing mortality
Fringed myotis	*Myotis thysanodes*	BLM UT BLM NV	Changes to riparian habitat availability, impacting foraging habitat
Hoary bat	Lasiurus cinereus	BLM NV	Changes to riparian habitat availability, impacting foraging habitat
Mexican free-tailed bat	*Tadarida brasiliensis*	BLM NV	Changes to riparian habitat availability, impacting foraging habitat
Pale Townsend's big-eared bat	*Corynorhinus townsendii pallescens*	BLM AZ	Changes to riparian habitat availability, impacting foraging habitat
Pallid bat	*Antrozous pallidus*	BLM NV	Changes to riparian habitat availability, impacting foraging habitat
Silver-haired bat	*Lasionycteris noctivagans*	BLM NV	Changes to riparian habitat availability, impacting foraging habitat
Townsend's big-eared bat	*Corynorhinus townsendii*	BLM AZ BLM CA BLM NV BLM UT	Changes to riparian habitat availability, impacting foraging habitat
Yuma myotis	*Myotis yumanensis*	BLM CA BLM NV	Changes to riparian habitat availability, impacting foraging habitat
Arizona toad	*Anaxyrus microscaphus*	BLM AZ BLM UT BLM NV	Changes to riparian habitat availability and water levels, impacting breeding and foraging habitat
Monarch butterfly	*Danaus plexippus plexippus*	BLM NV ESA Candidate	Changes to riparian habitat availability, impacting breeding and foraging habitat

Table 3-33
Special Status Species with Records between Glen Canyon Dam and Lake Mead and Potential Habitat Impacts Under the No Action Alternative

Common Name	Scientific Name	Status	Potential Impacts
Humpback chub	*Gila cypha*	Threatened	• Potential exists for reduced low velocity backwaters, although these are rare ephemeral habitats, but most important habitat is in the Little Colorado River, which would not be affected by the action. • Humpback chub grow faster with warmer temperatures, which allows them to evade predation. • Warmer temperatures are beneficial for nonnative fish such as smallmouth bass, which if they increase or become established, could be negative for humpback chub. • Reduced turbidity could lead to increased predation by nonnative fish.
Razorback sucker	*Xyrauchen texanus*	Endangered	• Potential exists for reduced low velocity backwaters, although these are rare, ephemeral habitats. • If smallmouth bass increase or become established, there could be increased competition and predation, which would be negative for razorback sucker. • Increased temperatures and decreased range in flow fluctuations are expected to have a positive impact on food base production and diversity.
Bluehead sucker	*Catostomus discobolus*	BLM AZ BLM UT	• Warmer temperatures are beneficial for nonnative fish such as smallmouth bass, which if they increase or become established, could be negative for bluehead sucker. • Warmer temperatures are beneficial for bluehead sucker spawning and growth.
Flannelmouth sucker	*Catostomus latipinnis*	BLM AZ BLM UT	• Warmer temperatures are beneficial for nonnative fish such as smallmouth bass, which if they increase or become established, could be negative for flannelmouth sucker. • Warmer temperatures are beneficial for flannelmouth sucker spawning and growth.

Common Name	Scientific Name	Status	Potential Impacts
Speckled dace	Rhinichthys osculus	BLM AZ	• Changes in water temperatures may cause this species to seek thermal refugia in tributaries or within the mainstem river; however, this species is tolerant to a wide range of temperatures but prefers cooler water temperatures. This species also moves between tributaries and the mainstem Colorado River seasonally • Changes in water temperatures may affect growth, survival, and reproduction • Changes in water levels may desiccate rocky habitats that provide habitat for this species near tributary confluences • Increases in smallmouth bass and other nonnative species may increase predation on speckled dace
American white pelican	*Pelicanus erythrorhynchos*	BLM UT	Neither this species nor its habitat occurs in the area where the proposed action would have any affect.
Arizona bell's vireo	*Vireo bellii arizonae*	BLM CA	Changes to water levels, impacting foraging and nesting habitat
Bald eagle	Haliaeetus leucocephalus	BLM AZ BLM NV BLM UT	Changes to water levels, impacting foraging habitat
California condor	Gymnogyps californianus	BLM AZ	Changes to water levels potentially increasing scavenging opportunities
Golden eagle	Aquila chrysaetos	BLM UT BLM AZ	Changes to water levels, potentially increasing scavenging opportunities
Southwestern willow flycatcher	Empidonax traillii extimus	Endangered BLM AZ BLM CA BLM NV	Changes to riparian habitat availability, impacting foraging and nesting habitat
Western yellow-billed cuckoo	Coccyzus americanus	Threatened BLM AZ BLM CA BLM NV	Changes to riparian habitat availability, impacting foraging and nesting habitat
Fringed myotis	*Myotis thysanodes*	BLM UT BLM NV	Changes to riparian habitat availability, impacting foraging habitat
Allen's lappet-browed bat	*Idionycteris phyllotis*	BLM AZ	Changes to riparian habitat availability and prey diversity, impacting foraging habitat
Arizona myotis	*Myotis occultus*	BLM AZ	Changes to riparian habitat availability and prey diversity, impacting foraging habitat
Big brown bat	*Eptesicus fuscus*	BLM NV	Changes to riparian habitat availability, impacting foraging habitat

Common Name	Scientific Name	Status	Potential Impacts
California myotis	*Myotis californicus*	BLM NV	Changes to riparian habitat availability and prey diversity, impacting foraging habitat
Canyon bat	*Parastrellus Hesperus*	BLM NV	Changes to riparian habitat availability and prey diversity, impacting foraging habitat
Cave myotis	*Myotis velifer*	BLM AZ BLM NV	Changes to riparian habitat availability and prey diversity, impacting foraging habitat
Desert bighorn sheep	Ovis canadensis nelsoni	BLM CA	Exposed soft sediments trapping individuals and causing mortality
Mexican free-tailed bat	*Tadarida brasiliensis*	BLM NV	Changes to riparian habitat availability, impacting foraging habitat
Mexican long-tongued bat	Choeronycteris mexicana	BLM AZ	Changes to riparian habitat availability, impacting foraging habitat
Pale Townsend's big-eared bat	*Corynorhinus townsendii pallescens*	BLM AZ	Changes to riparian habitat availability and prey diversity, impacting foraging habitat
Pallid bat	Antrozous pallidus	BLM NV	Changes to riparian habitat availability, impacting foraging habitat
Silver-haired bat	*Lasionycteris noctivagans*	BLM NV	Changes to riparian habitat availability and prey diversity, impacting foraging habitat
Spotted bat	*Euderma maculatum*	BLM AZ BLM NV BLM UT	Changes to riparian habitat availability and prey diversity, impacting foraging habitat
Western mastiff bat	*Eumops perotis*	BLM AZ BLM NV	Changes to riparian habitat availability and prey diversity, impacting foraging habitat
Yuma myotis	*Myotis yumanensis*	BLM CA BLM NV	Changes to riparian habitat availability and prey diversity, impacting foraging habitat
Relict leopard frog	*Rana onca*	BLM AZ BLM NV	Changes to riparian habitat availability and water levels, impacting breeding and foraging habitat
Monarch butterfly	*Danaus plexippus plexippus*	BLM NV ESA Candidate	Changes to riparian habitat availability, impacting breeding and foraging habitat

Summary

The types of impacts associated with each alternative are similar, as described above, as alternatives only vary by Lower Basin system conservation measures and Lake Powell annual releases below 7.0 maf. The No Action Alternative would result in similar impacts on special status species at Lake Powell and the Glen Canyon Dam to Lake Mead section compared with the Proposed Action until 2025. From 2025 to 2026, the Proposed Action would result in slightly higher water elevations at Lake Powell, resulting in reduced impacts on special status terrestrial wildlife, although the differences in impacts are likely to be minor.

Impacts on special status terrestrial wildlife at the Hoover Dam to the SIB would be slightly higher under the Proposed Action compared to the No Action Alternative; this is because water flows would be reduced to these sections to maintain higher water elevations in Lake Powell and Lake Mead.

Under the Proposed Action, the elevations of Lake Powell and Lake Mead would be expected to remain relatively stable (relative to the steady declines of the No Action Alternative). Under the driest hydrologic conditions, releases from Glen Canyon Dam under the Proposed Action would remain more consistent (steady declines) than under the No Action Alternative (with a large drop off in 2026), providing more stable habitats for the early life stages of humpback chub and other native fishes in the Colorado River. However, under slightly wetter hydrologies, releases from Glen Canyon could potentially decrease under the Proposed Action by up to 1.000 maf compared with the No Action Alternative. Such reductions under the Proposed Action would thus result in more reductions in habitat for native and listed fish species than the No Action Alternative.

Adult and large subadult smallmouth bass have been found in small numbers prior to 2022 in the Lees Ferry reach, near the Little Colorado River, and near Diamond Creek. These fish likely originated from passage through Glen Canyon Dam, moving down from reservoirs in the Little Colorado River, and movement upstream from Lake Mead, respectively. Young smallmouth bass have been found in 2022 and 2023, indicating local reproduction as a consequence of warmer releases from Glen Canyon Dam. Under the Proposed Action, this invasion of smallmouth bass may be somewhat abated by proposed flow releases, but is likely to continue and likely to impose an increased predation threat on native and listed fish species.

The Proposed Action would have greater impacts than the No Action Alternative in the driest of potential hydrologic futures. Over the period of analysis, both alternatives would result in increased entrainment of smallmouth bass through Glen Canyon Dam, increased smallmouth bass population growth, and potentially more interactions between native and nonnative fish resulting in increased predation. Technically there is a window of no entrainment for the No Action Alternative when releases are switched to the bypass valves where cold water would be released, and entrainment would stop. Under the Proposed Action, where lake elevations are high enough to negate the use of bypass valves, releases would switch to the penstocks through which entrainment could occur.

The No Action Alternative would result in greater impacts to fish compared with the Proposed Action for the driest hydrologic traces. Declining reservoir elevations in Lake Powell and Lake Mead have exposed deltaic sediments through which the Colorado River has carved a new channel. In Lake Powell, new channels—each about 30 miles long—have formed in the Colorado River and the San Juan River inflow. Razorback sucker and a few Colorado pikeminnow have been detected in these inflow areas. In Lake Mead, a new river channel of about 40 miles in length has been carved from Separation Canyon to Pearce Ferry, enabling the expansion of the population of humpback chub. Under the No Action Alternative, lake elevations would continue to decline; these riverine channels would continue to expand, which would potentially create more habitat. Under the Proposed Action, reservoir elevations would remain relatively stable and habitat would also remain stable.

No Action Alternative

Lake Powell

In some of the driest potential hydrologic futures (**Section 3.6.2**, **Figure 3-5**), Lake Powell elevations are projected to decline starting in summer 2023 and continue to decline through 2026.

Bald eagles and American white pelicans are the only special status species that utilize open-water habitat for foraging that have the potential to be affected (**Table 3-32**, also see **Appendix G**). Open-water habitat is expected to decline in Lake Powell during the analysis period. This could reduce foraging opportunities for these species. However, as a scavenger species, bald eagles, as well as golden eagles and California condors, may experience short-term benefits, as some carrion may become available during low water periods.

Bats often forage for insects over open water and riparian vegetation. Many insects use wet areas and riparian vegetation for breeding. Reduced water levels and velocity often benefit insect species. Increased habitat for insects could expand their populations, thereby increasing foraging opportunities for bats. Lower water levels could also increase invertebrate biodiversity and have subsequent effects on bat species. Therefore, the No Action Alternative may benefit bat species.

For species utilizing riparian areas along the waterline of Lake Powell, as water levels drop, the distance from the water's edge to existing riparian habitat would increase, potentially desiccating existing vegetation and reducing habitat quality until riparian vegetation grows along the newly established waterline. Newly exposed bank would likely be colonized by plant species that can establish quickly, which often include invasive species such as tamarisk (see the vegetation section). These fast-establishing plants provide cover for species utilizing these habitats, reducing potential impacts of declining water levels.

Monarch butterflies utilize meadows and areas with nectar-producing flowers as foraging habitat. They rely on milkweed (*Asclepias* spp.) for egg laying. This habitat type is found throughout the United States, Canada, and Mexico, and some milkweeds are riparian species (NatureServe 2023). It is unlikely that high-quality foraging habitat for this species would be affected by changes in flows, but some milkweeds are likely present in riparian and backwater areas. A reduction in flows may cause water stress to milkweeds and other flowering plants. Therefore, the No Action Alternative may impact individuals.

Desert bighorn sheep rely on lakes and streams for water sources year-round and frequently eat willow species (*Salix* spp.) along water edges during the winter for their diet. With the decline of water flows resulting in newly exposed banks and a potential decline in the riparian plant community (such as willows), important food sources for desert bighorn sheep could be diminished. Moreover, desert bighorn sheep could potentially get stuck in newly exposed loose soil ultimately ending in mortality. Rise and decline of lakes and streams are a natural process, and consistently pose this risk to desert bighorn sheep, though changes in flows may exacerbate this risk.

Glen Canyon Dam to Lake Mead

For the duration of the action, impacts on special status species would be similar to those described in the 2007 FEIS (Reclamation 2007) except for special status fish, as discussed below. The following discussion for non-fish species pertains to 2026, when flows could decrease depending on hydrology over the next couple of years and habitat declines would be expected to occur if water elevations continue to decrease.

Species that use riparian habitat and shallow water along the banks, such as the California black rail and the Arizona bell's vireo, could be affected through changes in habitat availability. As water levels drop, the distance from the water's edge to existing riparian habitat would increase, potentially desiccating existing vegetation and reducing habitat quality until riparian vegetation grows along the newly established waterline. This could include riparian habitat utilized for eagle nests and perching locations used for foraging. Newly exposed bank would likely be colonized by plant species that can establish quickly, which often include invasive species such as tamarisk (see the vegetation section). These fast-establishing plants would provide cover for species utilizing these habitats, reducing potential impacts of declining water levels.

As a scavenger species, bald eagles, as well as golden eagles and California condors, may experience short-term benefits, as some carrion may become available during low water periods with reduced flows and increased access to shoreline.

Bats often forage for insects over open water and riparian vegetation. Many insects use wet areas and riparian vegetation for breeding. Reduced water levels and velocity often benefit insect species. Increased habitat for insects could expand their populations, thereby increasing foraging opportunities for bats. Lower water levels could also increase invertebrate biodiversity and have subsequent effects on bat species. Therefore, the No Action Alternative may benefit bat species.

Impacts on monarch butterflies and desert big horned sheep would be similar to those described in the Lake Powell section.

Monarch butterflies utilize meadows and areas with nectar-producing flowers as foraging habitat. They rely on milkweed (*Asclepias* spp.) for egg laying. This habitat type is found throughout the United States, Canada, and Mexico, and some milkweeds are riparian species (NatureServe 2023). It is unlikely that high-quality foraging habitat for this species would be affected by changes in flows, but some milkweeds are likely present in riparian and backwater areas. A reduction in flows may cause water stress to milkweeds and other flowering plants. Therefore, the No Action Alternative may impact individuals.

Adult humpback chub use deep water recirculating eddies that are not affected by flow changes; however, age-0 individuals and juveniles use shoreline talus habitats that could be negatively affected by reduced flows, depending on the amount of water released. Although the core reproducing population of humpback chub is still in the Little Colorado River, a more recent aggregation in the western Grand Canyon has become established from Havasu Creek downstream to Pearce Ferry. This is likely due to the warmer water temperatures over the last 10 years and the formation of Pearce Ferry Rapid as a partial barrier to upstream movement of nonnative predators. Surveys from 2022 estimated the abundance of humpback chub in the western Grand Canyon as 40,000–60,000 between Havasu Rapid and Pearce Ferry (USGS 2023e). Because there are so few razorback suckers in the Grand Canyon, they are unlikely to be affected by reduced flows. However, if the flows were to result in a change to Pearce Ferry Rapid, nonnative fish could move into the Grand Canyon. A change in the hydrology and/or geomorphology of the Pearce Ferry Rapid could also lead to an increase of razorback sucker in Grand Canyon by allowing movement from Lake Mead.

Low reservoir elevation of Lake Powell and warm downstream releases increase the risk of warmwater predatory fish entering the Colorado River through the Grand Canyon. Green sunfish and smallmouth bass are found in the forebay, based on ongoing studies by Utah State University, and some are passing through the penstocks and being found in the slough below Glen Canyon Dam and other locations. These invasive species pose a predatory threat to the native fishes, including the largest population of humpback chub.

The interaction of flow, water temperature, and turbidity are likely to impact nonnative fish as well. Reduced flows and warming water temperatures are likely to provide more suitable conditions for spawning, egg incubation, and survival of young of warmwater nonnative species. Many of these species (e.g., channel catfish, bullheads, green sunfish, smallmouth bass, and largemouth bass) prey on and compete with native fish.

Cobble bars at tributary inflows like Spencer Creek may be used for spawning and would be desiccated by reduced flows. Warmer water temperatures may provide more suitable conditions for spawning and survival of young nonnative fish that are predators of native fish species.

Under the No Action Alternative, the GTMax model shows the elevation of Lake Powell would decline to minimum power pool (3,490 feet) from January through April 2024, which would require water to be released through the river outlets. Release temperatures through Glen Canyon Dam are projected to be as high as 20°C for certain hydrologic scenarios, and switching to releasing water through the river outlets would mean much colder release temperatures of 10–12°C. This cold-release regime would be similar to releases prior to 2004, when the reservoir was above 3,600 feet (Valdez et al. 2015). There could be an effect, however, on fish populations downstream of Glen Canyon Dam if water temperature releases rapidly shift from warm water to cold water. This colder release could temperature shock juvenile and adult rainbow trout in the Lees Ferry reach, as well as eggs and fry if they were in the gravel beds at the time the initial switch to cold water occurred, but they would be expected to recover. The water would warm longitudinally downstream, and the impact would be minimal on juvenile and adult humpback chub, razorback sucker, flannelmouth sucker, and bluehead sucker. However, sudden colder releases could temperature shock eggs, larvae, and age-0 members of these species depending on the timing of the switch to cold water through the river outlets.

Under the No Action Alternative, the likelihood that Lake Powell elevation would decrease below minimum power pool would increase. While daytime flows would not drop below the threshold of 8,000 cfs, they would likely be static, with less variation in river flows annually, seasonally, and daily. In Glen Canyon, rainbow trout would likely benefit from colder water released through the river outlets. The minimum, maximum, and optimal temperatures for growth of rainbow trout are 12, 21, and 16°C, respectively (Valdez et al 2015). Lethal temperature for rainbow trout is approximately 29°C (Chen et al. 2015), and modeling does not project water temperatures reaching or exceeding rainbow trout lethal temperatures in any month.

Lake Mead

Bald eagles and golden eagles are the only special status species that utilize open-water habitat for foraging that have the potential to be affected by project operations (**Table 3-34**, see also **Appendix G**). Open-water habitat is expected to decline in Lake Mead during the analysis period. This could reduce foraging opportunities for this species. However, as a scavenger species, bald eagles may experience short-term benefits, as some carrion may become available during low water periods.

Table 3-34
Special Status Species with Records at Lake Mead and Potential Habitat Impacts Under the No Action Alternative

Common Name	Scientific Name	Status	Potential Impacts
Humpback chub	*Gila cypha*	Threatened	Changes to water levels, impacting spawning and rearing habitat and increased predation on young
Razorback sucker	*Xyrauchen texanus*	Endangered	Changes to water levels, impacting spawning and rearing habitat and increased predation on young, possible adverse health impacts from algal blooms and dissolved oxygen changes due to increased temperatures and a decrease in the range of flow fluctuations
Bluehead sucker	*Catostomus discobolus*	BLM AZ BLM UT	Changes to water levels, impacting spawning and rearing habitat and increased predation on young
Flannelmouth sucker	Catostomus latipinnis	BLM AZ BLM UT	Changes to water levels, impacting spawning and rearing habitat and increased predation on young
Speckled dace	Rhinichthys osculus	BLM AZ	• Changes in water temperatures may cause this species to seek thermal refugia in tributaries or within the mainstem river; however, this species is tolerant to a wide range of temperatures but prefers cooler water temperatures. This species also moves between tributaries and the mainstem Colorado River seasonally • Changes in water temperatures may affect growth, survival, and reproduction • Changes in water levels may desiccate rocky habitats that provide habitat for this species near tributary confluences • Increases in smallmouth bass and other nonnative species may increase predation on speckled dace
Bald eagle	*Haliaeetus leucocephalus*	BLM AZ BLM NV BLM UT	Changes to water levels, impacting foraging habitat

Common Name	Scientific Name	Status	Potential Impacts
Golden eagle	Aquila chrysaetos	BLM UT BLM AZ	Changes to water levels, potentially increasing scavenging opportunities
Southwestern willow flycatcher	Empidonax traillii extimus	Endangered BLM AZ BLM CA BLM NV	Changes to riparian habitat availability, impacting foraging and nesting habitat
Western yellow-billed cuckoo	Coccyzus americanus	Threatened BLM AZ BLM CA BLM NV	Changes to riparian habitat availability, impacting foraging and nesting habitat
Allen's big-eared bat	*Idionycteris (=Plecotus) phyllotis*	BLM AZ BLM NV BLM UT	Changes to riparian habitat availability, impacting foraging habitat
Arizona myotis	*Myotis occultus*	BLM AZ	Changes to riparian habitat availability, impacting foraging habitat
Big brown bat	*Eptesicus fuscus*	BLM NV	Changes to riparian habitat availability, impacting foraging habitat
Big free-tailed bat	*Nyctinomops macrotis*	BLM NV	Changes to riparian habitat availability, impacting foraging habitat
California leaf-nosed bat	*Macrotus californicus*	BLM AZ BLM NV	Changes to riparian habitat availability, impacting foraging habitat
California myotis	*Myotis californicus*	BLM NV	Changes to riparian habitat availability, impacting foraging habitat
Canyon bat	*Parastrellus hesperus*	BLM NV	Changes to riparian habitat availability, impacting foraging habitat
Cave myotis	*Myotis velifer*	BLM AZ BLM NV	Changes to riparian habitat availability and prey diversity, impacting foraging habitat
Desert bighorn sheep	*Ovis canadensis nelsoni*	BLM CA	Exposed soft sediments trapping individuals and causing mortality
Fringed myotis	*Myotis thysanodes*	BLM UT BLM NV	Changes to riparian habitat availability, impacting foraging habitat
Hoary bat	*Lasiurus cinereus*	BLM NV	Changes to riparian habitat availability, impacting foraging habitat
Mexican free-tailed bat	*Tadarida brasiliensis*	BLM NV	Changes to riparian habitat availability, impacting foraging habitat
Pale Townsend's big-eared bat	*Corynorhinus townsendii pallescens*	BLM AZ	Changes to riparian habitat availability, impacting foraging habitat
Pallid bat	*Antrozous pallidus*	BLM NV	Changes to riparian habitat availability, impacting foraging habitat
Silver-haired bat	*Lasionycteris noctivagans*	BLM NV	Changes to riparian habitat availability, impacting foraging habitat
Townsend's big-eared bat	*Corynorhinus townsendii*	BLM AZ BLM CA BLM NV BLM UT	Changes to riparian habitat availability, impacting foraging habitat

Common Name	Scientific Name	Status	Potential Impacts
Western mastiff bat	*Eumops perotis*	BLM AZ BLM NV	Changes to riparian habitat availability, impacting foraging habitat
Western red bat	*Lasiurus blossevillii*	BLM NV BLM UT	Changes to riparian habitat availability, impacting foraging habitat
Western small-footed myotis	*Myotis ciliolabrum*	BLM CA BLM NV	Changes to riparian habitat availability, impacting foraging habitat
Yuma myotis	*Myotis yumanensis*	BLM CA BLM NV	Changes to riparian habitat availability, impacting foraging habitat
Desert tortoise	Gopherus agassizii	Threatened BLM NV	Neither this species nor its habitat occurs in the area where the proposed action would have any affect.
Lowland leopard frog	*Rana yavapaiensis*	BLM AZ BLM CA	Changes to riparian habitat availability and water levels, impacting breeding and foraging habitat
Relict leopard frog	*Rana onca*	BLM AZ BLM NV	Changes to riparian habitat availability and water levels, impacting breeding and foraging habitat
Mojave poppy bee	*Perdita meconis*	BLM NV	Changes to hydrology, impacting suitable habitat
Monarch butterfly	*Danaus plexippus plexippus*	BLM NV ESA Candidate	Changes to riparian habitat availability, impacting breeding and foraging habitat
Gold butte moss	*Ceratodon purpureus*	BLM NV	Changes to hydrology, impacting suitable habitat
Mokiak milkvetch	*Astragalus mokiacensis*	BLM NV	Changes to hydrology, impacting suitable habitat
Sticky buckwheat	*Eriogonum viscidulum*	BLM AZ BLM NV	Changes to hydrology, impacting suitable habitat

Species that utilize riparian habitat and shallow water along the banks, such as lowland leopard frog, could be affected through changes in habitat availability (see vegetation section). Impacts on riparian habitats used by these species would be similar to those described above in the Lake Powell section. Impacts on bat species would be similar to those described in the Glen Canyon Dam to Lake Mead section.

Southwestern willow flycatchers rely on dense riparian vegetation and large cottonwood trees for nesting and foraging habitat (NatureServe 2023). These habitats would take longer to reestablish along the new shoreline, potentially impacting southwestern willow flycatchers. This species would likely adjust its distribution to the unaffected tributaries that support riparian vegetation until new riparian vegetation reestablished along Lake Mead. The No Action Alternative may impact individuals, as described in the 2007 FEIS (Reclamation 2007), but it would not likely lead to population declines of southwestern willow flycatchers.

Impacts on bats would be similar to those described in the Lake Powell section of the No Action Alternative. In areas where new sediments are exposed, larger animals may become stuck in deep

mud and die. This is currently occurring and may be exacerbated with declining lake levels under this alternative.

Impacts on monarch butterflies and desert big horned sheep would be similar to those described in the Lake Powell section.

Special status plant species that grow in riparian habitat or in wet soils could be affected through changes in water availability. Some plant species have deep roots and can tolerate changes in water levels, while others are sensitive to change. Species that can tolerate drought periods and lower water levels may experience an increase in habitat availability as water levels recede, while species sensitive to these changes would likely experience a decrease in habitat availability.

Declining lake elevations would increase riverine habitat for humpback chub, razorback sucker, flannelmouth sucker, and bluehead sucker in the Colorado River inflow. While this may be a benefit for overall riverine habitat, declining elevation would also reduce shoreline spawning habitat for razorback sucker and nursery habitat for larvae in embayments and vegetated shorelines. Reduced lake elevation in spring would bring the lake below levels of emergent vegetation that are used by the larvae and age-0 fish for shelter and feeding. This would reduce survival and recruitment for the species.

Hoover Dam to the SIB

Under the No Action Alternative, the 2007 Interim Guidelines and subsequent agreements would continue to guide operations at Hoover Dam. Releases from Lake Mead would remain the same as existing conditions, depleting Lake Mead but maintaining similar water elevations from Lake Mead to SIB. Impacts on riparian vegetation and terrestrial wildlife species would, therefore, be similar to those described in the 2007 FEIS (Reclamation 2007).

Even in some of the driest potential hydrologic futures (**Section 3.6.2**, **Figure 3-8**), Lake Mead does not hit dead pool. Therefore, water is projected to be available to be released downstream through 2026.

Bald eagles and American white pelican are the only special status species that utilize open-water habitat for foraging that have the potential to be affected by project operations (**Table 3-35**, see also **Appendix G**). Open-water habitat is expected to decline in the Hoover Dam to SIB section during the analysis period. This could reduce foraging opportunities for this species. However, as a scavenger species, bald eagles, as well as golden eagles, may experience short-term benefits, as some carrion may become available during low water periods.

Species that utilize riparian vegetation, such as many of the birds and amphibians listed in **Table 3-35**, could benefit initially as new sediments are exposed and riparian habitat grows into areas that were previously inundated. However, beyond the 2026 analysis window, long-term impacts would likely be detrimental, given the level of water reductions expected in this reach.

Table 3-35
Special Status Species with Records between Hoover Dam and the SIB and Potential Habitat Impacts Under the No Action Alternative

Common Name	Scientific Name	Status	Potential Impacts
Bonytail chub	*Gila elegans*	Threatened	Changes to water levels, impacting spawning and nursery habitat, possible adverse health impacts from algal blooms and dissolved oxygen changes in Lake Mohave due to increased temperatures and a decrease in the range of flow fluctuations
Razorback sucker	*Xyrauchen texanus*	Endangered	Changes to water levels, impacting spawning and nursery habitat, possible adverse health impacts from algal blooms and dissolved oxygen changes in Lake Mohave due to increased temperatures and a decrease in the range of flow fluctuations
Desert pupfish	*Cyprinodon macularius*	Endangered	Changes to water levels, impacting spawning and nursery habitat
Flannelmouth sucker	*Catostomus latipinnis*	BLM AZ BLM UT	Changes to water levels, impacting spawning and nursery habitat
Speckled dace	*Rhinichthys osculus*	BLM AZ	• Changes in water temperatures may cause this species to seek thermal refugia in tributaries or within the mainstem river; however, this species is tolerant to a wide range of temperatures but prefers cooler water temperatures. This species also moves between tributaries and the mainstem Colorado River seasonally • Changes in water temperatures may affect growth, survival, and reproduction • Changes in water levels may desiccate rocky habitats that provide habitat for this species near tributary confluences • Increases in smallmouth bass and other nonnative species may increase predation on speckled dace

Common Name	Scientific Name	Status	Potential Impacts
American white pelican	*Pelecanus erythrorhynchos*	BLM UT	Changes to open-water habitat availability and salinity, impacting foraging habitat
Arizona bell's vireo	*Vireo bellii arizonae*	BLM CA	Changes to water levels, impacting foraging and nesting habitat
Bald eagle	*Haliaeetus leucocephalus*	BLM AZ BLM NV BLM UT	Changes to water levels, impacting foraging habitat
California black rail	*Laterallus jamaicensis coturniculus*	BLM AZ BLM CA	Changes to riparian habitat availability, impacting foraging and nesting habitat
Crissal thrasher	*Toxostoma crissale*	BLM CA	Changes to water levels, impacting foraging and nesting habitat
Elf owl	Micrathene whitneyi	BLM CA	Changes to water levels, impacting foraging and nesting habitat
Gila woodpecker	*Melanerpes uropygialis*	BLM CA	Changes to water levels, impacting foraging and nesting habitat
Gilded flicker	*Colaptes chrysoides*	BLM AZ BLM CA	Changes to water levels, impacting foraging and nesting habitat
Golden eagle	*Aquila chrysaetos*	BLM UT BLM AZ	Changes to water levels, potentially increasing scavenging opportunities
Lucy's warbler	*Leiothlypis luciae*	BLM CA	Changes to water levels, impacting foraging and nesting habitat
Mountain plover	*Charadrius montanus*	BLM CA	Changes to water levels, impacting foraging habitat
Southwestern willow flycatcher	*Empidonax traillii extimus*	Endangered BLM AZ BLM CA BLM NV	Changes to riparian habitat availability, impacting foraging and nesting habitat
Tricolored blackbird	*Agelaius tricolor*	BLM CA	Changes to riparian habitat availability, impacting foraging and nesting habitat
Western yellow-billed cuckoo	*Coccyzus americanus*	Threatened BLM AZ BLM CA BLM NV	Changes to riparian habitat availability, impacting foraging and nesting habitat
White-tailed kite	*Elanus leucurus*	BLM CA	Changes to riparian habitat availability, impacting foraging habitat
Yuma Ridgway's rail	*Rallus obsoletus yumanensis*	Endangered BLM AZ BLM CA BLM NV	Changes to riparian habitat availability, impacting foraging habitat
Arizona myotis	*Myotis occultus*		Changes to riparian habitat availability, impacting foraging habitat

Common Name	Scientific Name	Status	Potential Impacts
Big brown bat	*Eptesicus fuscus*	BLM NV	Changes to riparian habitat availability, impacting foraging habitat
Big free-tailed bat	Nyctinomops macrotis	BLM NV	Changes to riparian habitat availability, impacting foraging habitat
California leaf-nosed bat	*Macrotus californicus*	BLM AZ BLM NV	Changes to riparian habitat availability, impacting foraging habitat
California myotis	*Myotis californicus*	BLM NV	Changes to riparian habitat availability, impacting foraging habitat
Canyon bat	Parastrellus hesperus	BLM NV	Changes to riparian habitat availability, impacting foraging habitat
Cave myotis	*Myotis velifer*	BLM AZ BLM NV	Changes to riparian habitat availability, impacting foraging habitat
Desert bighorn sheep	*Ovis canadensis nelsoni*	BLM CA	Exposed soft sediments trapping individuals and causing mortality
Hoary bat	*Lasiurus cinereus*	BLM NV	Changes to riparian habitat availability, impacting foraging habitat
Long-eared myotis	*Myotis evotis*	BLM CA	Changes to riparian habitat availability, impacting foraging habitat
Mexican free-tailed bat	*Tadarida brasiliensis*	BLM NV	Changes to riparian habitat availability, impacting foraging habitat
Mexican long-tongued bat	Choeronycteris mexicana	BLM AZ	Changes to riparian habitat availability, impacting foraging habitat
Pale Townsend's big-eared bat	*Corynorhinus townsendii pallescens*	BLM AZ	Changes to riparian habitat availability, impacting foraging habitat
Pallid bat	*Antrozous pallidus*	BLM NV	Changes to riparian habitat availability, impacting foraging habitat
Silver-haired bat	*Lasionycteris noctivagans*	BLM NV	Changes to riparian habitat availability, impacting foraging habitat
Spotted bat	*Euderma maculatum*	BLM AZ BLM NV BLM UT	Changes to riparian habitat availability, impacting foraging habitat

Common Name	Scientific Name	Status	Potential Impacts
Townsend's big-eared bat	*Corynorhinus townsendii*	BLM AZ BLM CA BLM NV BLM UT	Changes to riparian habitat availability, impacting foraging habitat
Western mastiff bat	*Eumops perotis*	BLM AZ BLM NV	Changes to riparian habitat availability, impacting foraging habitat
Western red bat	*Lasiurus blossevillii*	BLM NV BLM UT	Changes to riparian habitat availability, impacting foraging habitat
Western small-footed myotis	*Myotis ciliolabrum*	BLM CA BLM NV	Changes to riparian habitat availability, impacting foraging habitat
Yuma myotis	*Myotis yumanensis*	BLM CA BLM NV	Changes to riparian habitat availability, impacting foraging habitat
Arizona toad	*Anaxyrus microscaphus*	BLM UT BLM NV	Changes to riparian habitat availability and water levels, impacting breeding and foraging habitat
Couch's spadefoot	*Scaphiopus couchii*	BLM CA	Changes to riparian habitat availability, impacting foraging and breeding habitat
Desert tortoise	*Gopherus agassizii*	Threatened BLM NV	Neither this species nor its habitat occurs in the area where the proposed action would have any affect.
Lowland leopard frog	*Rana yavapaiensis*	BLM AZ BLM CA	Changes to riparian habitat availability and water levels, impacting breeding and foraging habitat
Northern Mexican garter snake	*Thamnophis eques megalops*	Threatened	Changes to riparian habitat availability and water levels, impacting breeding and foraging habitat
Relict leopard frog	*Rana onca*	BLM AZ BLM NV	Changes to riparian habitat availability and water levels, impacting breeding and foraging habitat
Monarch butterfly	*Danaus plexippus plexippus*	BLM NV ESA Candidate	Changes to riparian habitat availability and water levels, impacting breeding and foraging habitat
Mojave tarplant	*Deinandra mohavensis*	BLM CA	Changes to hydrology, impacting suitable habitat

Common Name	Scientific Name	Status	Potential Impacts
Parish's meadowfern	*Limnanthes alba* ssp. *parishii*	BLM CA	Changes to hydrology, impacting suitable habitat
Variegated dudleya	*Dudleya variegata*	BLM CA	Changes to hydrology, impacting suitable habitat

Northern Mexican garter snakes have been detected at Havasu NWR and the Bill Williams NWR. This species was previously considered extirpated from these areas. This species relies on wetland and aquatic habitat for foraging on small fish and amphibians (Northern Arizona University 2023). Reduced water elevations could impact riparian habitat and wetlands used by Northern Mexican garter snakes.

Impacts on monarch butterflies would be similar to those described in the Lake Powell section.

Impacts on bat species would be similar to those described in the Lake Powell section. Impacts on special status plant species would be similar to those described in the Lake Mead section.

Overall, reductions in water availability would have the same impacts on native fish through reduction of habitat such as backwater and floodplains for larval razorback sucker, bonytail chub, and flannelmouth sucker.

Salton Sea

According to the updated SSAM and projections of future IID water delivery using Reclamation's CRSS model, the No Action Alternative would exacerbate a decrease in water level and a corresponding increase in exposed playa beginning in late 2025/early 2026, thereby exacerbating existing issues of water availability and salinity for special status species (see **Table 3-36**). As shortages increase over time, riparian vegetation along the banks of the Salton Sea is likely to become exposed and thus more likely to be colonized by invasive species (see vegetation section). Decreasing water levels would also increase salinity, potentially leading to reductions in aquatic prey availability for wildlife that utilize the Salton Sea as foraging and migration habitat.

American white pelicans utilize open-water habitat for foraging. Open-water habitat is expected to decline in the Salton Sea under the No Action Alternative during the analysis period, which would result in increased salinity. This could reduce foraging opportunities for these species, which rely on the Salton Sea as an important migration stopover site.

Species that use riparian habitat, such as the Crissal thrasher, mountain plover, and white-tailed kite, and those that use shallow water along the banks, such as the California black rail and Yuma Ridgway's rail, could be affected through changes in habitat availability (see the vegetation section). As water levels drop, the distance from the water's edge to existing riparian habitat would increase, potentially desiccating existing vegetation and reducing habitat quality until riparian vegetation grows along the newly established waterline. Newly exposed bank would likely be colonized by plant species that can establish quickly, which often include invasive species such as tamarisk (see the vegetation section). These fast-establishing plants provide cover for species utilizing these habitats, reducing potential impacts of declining water levels.

Table 3-36
Special Status Species with Records at the Salton Sea and Potential Habitat Impacts Under the No Action Alternative

Common Name	Scientific Name	Status	Potential Impacts
Desert pupfish	*Cyprinodon macularius*	Endangered	Changes in water volume, impacting habitat availability of nearshore pools
Yuma Ridgway's rail	*Rallus obsoletus yumanensis*	Endangered BLM AZ BLM CA BLM NV	Changes to riparian and wetland habitat, impacting foraging and nesting habitat
American white pelican	*Pelecanus erythrorhynchos*	BLM UT	Changes to open-water habitat availability and salinity, impacting foraging habitat
California black rail	*Laterallus jamaicensis coturniculus*	BLM AZ BLM CA	Changes to riparian habitat, impacting foraging and nesting habitat
Crissal thrasher	*Toxostoma crissale*	BLM CA	Changes to riparian habitat, impacting foraging and nesting habitat
Mountain plover	*Charadrius montanus*	BLM CA	Changes to riparian and open-water habitat availability and salinity, impacting foraging and nesting habitat
White-tailed kite	*Elanus leucurus*	BLM CA	Changes to riparian and open-water habitat availability and salinity, impacting foraging and nesting habitat

Proposed Action

Lake Powell

Overall, the Proposed Action would maintain water levels similar to those of the No Action Alternative in Lake Powell until late 2025, when the Proposed Action would begin to diverge from the No Action Alternative. More water would be available in Lake Powell under the Proposed Action. Therefore, the magnitude of effects is greater under the No Action Alternative. However, impacts on vegetation are predicted to be the same between the two alternatives (**Section 3.13.2**, **Issue 1**). Given that the predicted elevations and vegetation models are only marginally different, no population level impacts are expected on special status species of terrestrial wildlife.

Under the Proposed Action, the elevation of Lake Powell would not be allowed to drop below the minimum power pool elevation of 3,500 feet, although the driest hydrologic traces show that it may drop below this level. Lake Powell releases can be reduced to as low as 6.0 maf to maintain this elevation. This alternative would maintain extended fish habitat in the Colorado River and San Juan River inflows. If the elevation of the lake rises in 2026, some of the newly created river habitat would be reduced, but the species in the inflows have adapted to these changes. About 30 miles of

inflow riverine habitat has been created by lowered lake elevations in the Colorado River inflow and the San Juan River inflow, but the amount that would be inundated by an increasing lake elevation is not likely to be significant.

Glen Canyon Dam to Lake Mead

Water elevation at Lake Powell would be similar to the No Action Alternative through late 2025 and then higher than the No Action Alternative to 2026, which would result in lower river flows in this section. Therefore, the magnitude of effects would be greater under the Proposed Action. However, the riparian vegetation model projects similar native plant species cover and richness under the Proposed Action compared with the No Action Alternative in all modeled areas. Nonnative plant species cover and richness is projected to be similar under the Proposed Action compared with the No Action Alternative. Nonnative plant species typically provide lower-quality habitat than native species for wildlife species and can lead to monotypic habitat types that support fewer wildlife species (NatureServe 2023). Given that the predicted flows and vegetation models are only marginally different, no population level impacts are expected on special status terrestrial wildlife.

Under the Proposed Action, operations would be adjusted to maintain an elevation above 3,500 feet. Lake Powell releases can be reduced to as low as 6.0 maf to maintain this elevation. This would allow water to continue to be released through Glen Canyon Dam, although at a reduced level in some years. In years when reduced water was released, reduced shoreline habitat and backwaters would be available for use by age-0, juvenile, and subadult humpback chub (although the major reproducing population of humpback chub is in the Little Colorado River, which would be unaffected by the reduced flows). If a nonnative fish, such as smallmouth bass, were to increase and become established, there would likely be an increase in predation on native species.

With the Proposed Action there would be a greater chance of staying above power pool and having more variability annually, seasonally, and daily in river flows. This would mean there may be some individual years of low flow, but those may be followed by higher annual flow years. In Glen Canyon, there may be warmer or cooler years and years with low dissolved oxygen followed by years where dissolved oxygen is not a concern. There would be increased chances of warmwater nonnative fishes increasing in numbers and preying on rainbow trout during these low flow releases.

Lake Mead

Overall, the Proposed Action would maintain higher water levels than those of the No Action Alternative in Lake Mead. Given the limited amount of riparian habitat available around Lake Mead, most species that utilize riparian habitat in this area are likely habitat generalists that have adapted to changing riparian habitat availability over the preceding years (Reclamation 2007). Therefore, the magnitude of effects would be greater under the No Action Alternative. Given that the predicted elevations are only marginally different, no population level impacts are expected on special status terrestrial wildlife.

Hoover Dam to the SIB

Releases from Lake Mead would be reduced to maintain higher elevations in Lake Mead, reducing water elevations from Hoover Dam to the SIB. Impacts on riparian vegetation and terrestrial wildlife species would, therefore, be greater under the Proposed Action than the No Action Alternative.

Reduced flows resulting from the Proposed Action would result in a lower river stage in this section that could have impacts on up to 41 acres of emergent marsh vegetation in addition to marsh habitat affected under the No Action Alternative. This may cause direct loss of vegetation through desiccation and the fragmentation or reduction in the extent of habitat patches. The Proposed Action may also affect up to 133 acres of cottonwood-willow vegetation in addition to riparian habitat affected under the No Action Alternative. Therefore, the magnitude of effects to special-status species that use these habitats would be greater under the Proposed Action (**Section 3.6.2**, **Figure 3-8**). Reclamation has proposed measures to offset these impacts to marsh and cottonwood-willow habitats; these measures will be finalized through the Section 7 consultation process.

Loss of fish habitat would be proportional to loss of backwater areas described by Reclamation in the backwater model, where up to 109 acres may be impacted by reduced river flows under the Proposed Action. Razorback sucker and bonytail that are stocked in these backwaters would have less habitat when total volume of water is reduced. Under the Proposed Action, flows would be lower but there would be no substantive effects expected to water quality. However, lower flows may affect connectivity and extent of backwaters.

Salton Sea

According to the updated SSAM and projections of future IID water delivery using Reclamation's CRSS model, the Proposed Action would expedite previously anticipated decreases in water level and corresponding increases in exposed playa at the Salton Sea beginning in 2024, worsening existing issues of water availability and salinity for special status species as compared with the No Action Alternative. However, the U.S. Army Corps of Engineers' Salton Sea Management Program (U.S. Army Corps of Engineers 2023) would mitigate losses and help to provide additional wildlife habitat. The Proposed Action indicates that 840,000 acre-feet of additional water conservation between 2024 and 2026 would be undertaken by Imperial Irrigation District and Coachella Valley Water District. This water conservation is in addition to commitments made under the Quantification Settlement Agreement, so declines in wetlands supported by agricultural drain runoff would be in addition to what would occur under the No Action Alternative. This would benefit the desert pupfish and Yuma Ridgway's rail that occur in the permanent wetlands downstream of agricultural drains that drain into the exposed lakebed surrounding the Salton Sea.

Cumulative Effects

One of the stated purposes of the Salton Sea Management Program's 10-Year Plan is to improve habitat for fish and wildlife through mitigating effects of decreasing water levels and increased salinity in recent years (California Natural Resources Agency 2021). The construction of ponds and aquatic habitat is intended to restore habitat at appropriate salinity levels to support fish and wildlife. This will result in a positive impact on special status terrestrial wildlife species, including Yuma Ridgway's rail.

Reclamation's Upper Colorado Basin Region is preparing an SEIS to the LTEMP regarding experimental operations at the Glen Canyon Dam that will analyze flow options from Glen Canyon Dam to prevent smallmouth bass from establishing below the dam by preventing additional spawning. If one of the flow options that is being evaluated through the LTEMP SEIS were to be implemented, this action would cumulatively impact aquatic species within the Colorado River

below Glen Canyon Dam to Lake Mead by reducing the temperatures of water released. The intent of this cumulative action is to prevent spawning of smallmouth bass. If Lake Powell were to decrease to minimum power pool elevation of 3,490 feet, water would be released through the river outlets out of necessity, nullifying this cumulative action. Implementation of one of the LTEMPS SEIS flow options would not result in changes to the annual volumes of reservoir releases from Glen Canyon Dam (Lake Powell) or Hoover Dam (Lake Mead).

3.14 Recreation

3.14.1 Affected Environment

This SEIS builds on the 2007 FEIS, which identifies and describes in detail the following key recreation resources or issues:

- Shoreline public use
- Reservoir boating
- River and whitewater boating
- Sport fishing

This section provides updated information, data, and conditions for these resources since the publication of the 2007 FEIS.

Shoreline Public Use

The following sections describe shoreline public use associated with boating facilities (marinas, boat docks, and boat launch ramps), access to points of interest, and other opportunities within each Colorado River reach. Recreational boating in the study area depends on these major shoreline access points. While fluctuation in pool elevations is a normal aspect of reservoir operations, changes in pool elevations or increased variations or rates in pool elevation fluctuation could result in changes in operation costs and temporary closures. Below critical pool elevations and river flows, certain facilities may be rendered inoperable or may require relocation to maintain their operation. (Additional information on recreational boating and boating facilities can be found in the 2007 FEIS Section 3.12.1; the information is incorporated by reference.)

Lake Powell and Glen Canyon Dam

Lake Powell is entirely within the GCNRA, which receives approximately three to four million visitors each year (NPS 2023f). **Table 3-37** summarizes visitation to GCNRA for the most recent 6 years.

Table 3-37
Glen Canyon National Recreation Area Recreational Visitors

Year	Recreational Visitors
2017	4,574,940
2018	4,219,441
2019	4,330,563

Year	Recreational Visitors
2020	2,553,392
2021	3,144,318
2022	2,842,776

Source: NPS 2023f

Table 3-38 summarizes the total number of visits to GCNRA by visitor segment for 2022, the most recent year for which data are available.

Table 3-38
Glen Canyon National Recreation Area Visits by Visitor Segment for 2022

Recreation Visitors	Non-Recreation Visitors*	Concession Lodging	Tent Campers	RV Campers	Concession Camping	Backcountry Camping	Misc. Campers	Total Overnight Stays
2,842,776	23,322	23,636	9,647	10,799	2,286	2,308	518,772	567,449

Source: NPS 2023g

*The NPS defines reportable non-recreation visits to include:

- Persons going to and from inholdings across significant parts of park land
- Commuter and other through traffic using NPS-administered roads or waterways through a park for their convenience
- Tradespeople with business in the park
- Any civilian activity that is a part of or incidental to the pursuit of a gainful occupation (for example, guides)
- Government personnel (other than NPS employees) with business in the park
- Citizens using NPS buildings for civic or local government business, or attending public hearings
- Outside research activities (visits and overnights), if they are independent of NPS-legislated interests (for example, meteorological research) (NPS 2022c)

Lake Powell, with its many side canyons and related natural, cultural, and geologic resources, is the primary recreation feature of GCNRA. Recreation that occurs at Lake Powell includes swimming and sunbathing, power boating, waterskiing, fishing, off-beach activities associated with boat trips (such as hiking and exploring archaeological sites), house boating, personal watercraft use, canoeing, kayaking, sailing, wildlife viewing, photography, sightseeing, diving, and other activities. Visitors can enjoy camping opportunities ranging from going to remote and undeveloped campsites to going to fully developed campgrounds. Visitors can also see archaeologically and culturally important sites throughout the GCNRA.

Recreational boating is the most important recreational activity on Lake Powell, nearly two million visitors accessing the reservoir by either private boat or rental (NPS 2023h). Specific boating facilities and reservoir elevations important to their operation are discussed in the 2007 FEIS and summarized in **Table 3-39**. Water-based recreational facilities at Lake Powell include Wahweap, Halls Crossing, Bullfrog, and Antelope Point marinas. Since the publication of the 2007 FEIS, declining water levels have rendered the Dangling Rope Marina inoperable since 2021; this marina

Table 3-39
Critical Elevations for Lake Powell by Boating Facility

Lake Elevation (feet)	Impact and Facility
3,700	Full pool
3,645	Hite Marina would need to be reconfigured and possibly moved; Hite Public Launch Ramp closed
3,587	Antelope Point Public Ramp closed
3,580	Castle Rock Cut closed
3,562	Stateline Public Launch Ramp closed
3,553	Halls Crossing Marina would need to be reconfigured and possibly moved
3,551	Wahweap Main Ramp closed
3,530	Antelope Point Business Ramp closed
3,525	Bullfrog North Ramp closed
3,522	Stateline Auxiliary closed
3,490	Main Bullfrog Launch Ramp closed

Source: Heidie Grigg, GCNRA Acting Chief of External Affairs, NPS, personal communications, March 16, 2023

previously provided boating access to Rainbow Bridge National Monument. The Hite Launch Ramp has also been closed since 2012 due to the ramp being out of the water (NPS 2023i).

Changes to the shoreline affect the usability of boat launch ramps throughout the year, especially in warmer months. Launch ramp closures resulting from declining water levels have resulted in longer lines, limited parking, and congestion at boat ramps and docks (NPS 2023i).

In 2022, the NPS received $26 million in Disaster Supplemental Funding to provide additional boating access at Lake Powell. Design work is proceeding for a North Lake Powell ramp that reaches an elevation of 3,450 feet in the Stanton Creek area. The NPS is also working to develop schematic designs for the Antelope Point Public Ramp, Halls Crossing Public Ramp, and primitive ramp and take-out area at the Hite Marina. The NPS continues to seek funding necessary for potential reconstruction. The NPS is also continuing to seek funds to replace the services previously offered at Dangling Rope Marina, a long-term solution for lake access to Rainbow Bridge National Monument, and a Navigable Waterway Congestion Study in South Lake Powell (NPS 2023i).

Access to Points of Interest

As previously mentioned, as of 2021 there is no longer dock access to the Rainbow Bridge National Monument shoreline. Access is limited to the Rainbow Bridge Trail. Visitors generally have to leave boats and small vessels at the shoreline and often traverse through mud, debris, sand, and water before reaching the established trail. While no longer connected to the shoreline, the Rainbow Bridge dock system is accessible with restroom facilities. The concessionaire-operated tours to the monument are no longer able to access the area, thus removing access for most GCNRA visitors. Visitors can also access Rainbow Bridge National Monument by obtaining a permit from the Navajo Nation Parks and Recreation Department to backpack for multiple days on Navajo Tribal lands from Navajo Mountain; however, this is not possible for many visitors (NPS 2021).

Harmful Algal Blooms

Warming water temperatures and increased inputs of nutrients from monsoonal storms create conditions that are more conducive to the growth of harmful algal blooms. Harmful algal blooms produce toxins that pose serious health risks to humans and animals (NPS 2019). (Water quality concerns are described in detail in **Section 3.8**.)

Quagga Mussel Shells on Shorelines

Quagga mussels were first detected at Lake Powell in 2012. They are particularly prevalent toward the southern area of the lake, where seasonally low water levels are now exposing mussel-encrusted shoreline (NPS 2016). Quagga mussel shells eventually wash up on beaches and can cut through skin, clothing, and pet paws.

Hiking and Sightseeing in Glen Canyon

Declining water levels have exposed approximately 100,000 acres of Glen Canyon that were previously inundated by Lake Powell, creating new opportunities to view landscapes and archaeological sites that have been underwater since the late 1960s (Baker 2022; Kolbert 2021). These include arches, side canyons, other rock formations, and lush desert ecosystems. This has created new hiking and sightseeing opportunities for GCNRA visitors since the publication of the 2007 FEIS.

Glen Canyon Dam to Lake Mead

The 15.5-mile river reach downstream of Glen Canyon Dam to Lees Ferry is managed by GCNRA; it is used by anglers, campers, commercial float trip operators, kayakers, and other boaters. Fishing opportunities for rainbow and brown trout also occur downstream of this reach. In the last five years, warming water temperatures have made this reach more attractive for day and overnight use by paddle boarders, kayakers, and canoeists, resulting in increased visitation.

The NPS manages most of the reach, except where it is bordered on the east by the Navajo Indian Reservation and on the south by the Hualapai Indian Reservation. GCNP staff regulates visitor use of the Colorado River downstream of Lees Ferry in accordance with the Colorado River Management Plan (NPS 2006a, 2006b).

Grand Canyon National Park begins downstream of the Lees Ferry boat ramp at the confluence of the Colorado and Paria Rivers. Designated a United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Site in 1979, Grand Canyon National Park is valued for its superlative natural and cultural resources as well as its varied recreational experiences. Approximately 94 percent of GCNP (1,143,918 acres) qualifies as wilderness, as described in the 1964 Wilderness Act (Public Law 88-577) and NPS Management Policies 2006 (NPS 2006b). This includes 10,919 acres of potential wilderness along the Colorado River corridor.

The Colorado River corridor borders Tribal lands for nearly half the distance from the put-in at Lees Ferry to the last takeout at Pearce Ferry. The Navajo Indian Reservation borders GCNP along the eastern bank of the Colorado River from near Lees Ferry to the confluence with the Little Colorado River at river mile (RM) 61.8. The Hualapai Indian Reservation borders the river corridor for approximately 108 miles from upstream of National Canyon (RM 167) to approximately RM 274.

The Hualapai Indian Reservation offers camping, fishing, hiking, and big game hunting. Tribal enterprises offer rafting trips on the Colorado River between Diamond Creek and Pearce Ferry. The NPS coordinates with Tribal neighbors to address resource management and visitor use concerns along shared boundaries. Access permits from the Navajo Nation, Havasupai Tribe, or Hualapai Tribe are required by each respective Tribe to access and recreate on Tribal lands.

GCNP receives 4 to 6 million visitors each year (NPS 2023j). **Table 3-40** summarizes visitation to GCNP for the most recent 6 years.

Table 3-40
Grand Canyon National Park Recreational Visitors

Year	Recreational Visitors
2017	6,254,238
2018	6,380,495
2019	5,974,411
2020	2,897,098*
2021	4,532,677
2022	4,732,101

Source: NPS 2023j
*Park closure April–May due to the COVID-19 pandemic

Table 3-41 summarizes the total number of visits to GCNP by visitor segment for 2022, the most recent year for which data are available.

Table 3-41
GCNP Visits by Visitor Segment for 2022

Recreation Visitors	Non-Recreation Visitors*	Concession Lodging	Tent Campers	RV Campers	Concession Camping	Backcountry Camping	Misc. Campers	Total Overnight Stays
4,732,101	7,720	526,467	89,825	56,759	39,400	331,623	14,141	1,058,215

Source: NPS 2023k
*The NPS defines reportable non-recreation visits to include:

- Persons going to and from inholdings across significant parts of park land
- Commuter and other through traffic using NPS-administered roads or waterways through a park for their convenience
- Tradespeople with business in the park
- Any civilian activity that is a part of or incidental to the pursuit of a gainful occupation (for example, guides)
- Government personnel (other than NPS employees) with business in the park
- Citizens using NPS buildings for civic or local government business, or attending public hearings
- Outside research activities (visits and overnights), if they are independent of NPS-legislated interests (for example, meteorological research) (NPS 2022a)

The Lees Ferry to Diamond Creek reach has relatively low-use densities and levels of development that provide opportunities for solitude on the Colorado River as well as at many camps and attraction sites. This section of the Colorado River is where the majority of whitewater boating occurs. Takeouts are at Diamond Creek and Pearce Ferry. The reach downstream of Diamond Creek offers different recreation opportunities from those of the river reach upstream as it transitions to a more populated and developed setting. Whitewater boating trips become intermingled with very high levels of general boating and recreation use in the Quartermaster area. **Section 3.16** describes the social and economic importance of whitewater boating in the Grand Canyon.

Helicopter operations authorized by the Hualapai Tribe transport people into the Grand Canyon and connect them with motorized pontoon boats that give 20-minute tours of the Quartermaster area. These same helicopters provide a dual service in flying out boaters who have traveled from Diamond Creek on commercial motor day trips.

Boating Facilities

No boating facilities are within GCNP. Development along the Colorado River within the park is limited to the development at Phantom Ranch (RM 88) and Pipe Creek (RM 89.5). Other focal points include the launch ramp at Lees Ferry (within GCNRA), the helipad near Whitmore Wash (RM 187) on the Hualapai Reservation, the road access and minor structures operated by the Hualapai Tribe at Diamond Creek (RM 226), and the tourist area near Quartermaster Canyon (RM 260).

Camping between Glen Canyon Dam and Lake Mead occurs in GCNP on undeveloped beaches (sandbars) along the Colorado River. The number and usability of campsites vary from year to year based on the magnitude of releases from Glen Canyon Dam and local topography. Additional factors include vegetation changes; erosion from tributary flooding, wind, and recreation use; and the closure of sites to protect sensitive resources (NPS 2006a).

The average annual release volume was 9.1 maf from 2007 to 2019 and 8.1 maf from 2020 to 2022. The recent years of low release volumes have allowed accumulation of sand on the riverbed; sand was not redistributed to camping beaches from 2019 through 2022 due to a lack of HFEs. From 2012 to 2018, there were more frequent HFEs, which build more sandbars and beaches, on average, in Marble and Grand Canyons. The lack of HFEs from 2019 through 2022 has resulted in greater erosion than deposition on the high-elevation sandbars, due to erosive flows in the main channel and gullying from side channels with no rebuilding. Also, the lack of HFEs has contributed to more vegetation encroachment since 2018 (USGS 2023f).

Of the 276 campsites referenced in Section 3.12.1.1 of the 2007 FEIS, 195 sites are still classified as "camps"; 68 sites have been classified as "noncamps" due to sand erosion, vegetation overgrowth, or both; 2 sites could not be ascertained based on the float-by methodology used during the November 2022 NPS Colorado River Management Plan (CRMP) monitoring trip; and 10 campsites were not evaluated (Kearsley 2023).

Lake Mead and Hoover Dam

LMNRA contains 1.5 million acres. It encompasses the 110-mile-long Lake Mead, the 67-mile-long Lake Mohave, the surrounding desert, and the isolated Shivwits Plateau in Arizona. Recreation such as camping, boating, fishing, and hiking occurs on upper Lake Mead. The Overton Wildlife Management Area provides opportunities for wildlife viewing and photography, waterfowl and upland game bird hunting, hiking, and fishing. The Overton Wildlife Management Area has an average of 4,226 annual visitor use days (Nevada Department of Wildlife, personal communication, 2023).

LMNRA extends along the lower Colorado River from the western border of Grand Canyon National Park to Davis Dam. Primary recreational activities on Lake Mead include cruising/sailing, personal watercraft usage, waterskiing, fishing, swimming, and diving. A number of campgrounds and picnic areas, including Boulder Beach, Calville Bay, Echo Beach, Las Vegas Bay, and Temple Bar, provide additional recreational opportunities. LMNRA had approximately 5.6 million visitors in 2022 (NPS 2023l).

Table 3-42 summarizes recreational visits to LMNRA for the last 6 years.

Table 3-42
Lake Mead National Recreation Area Recreational Visitors

Year	Recreational Visitors
2017	7,882,339
2018	7,578,958
2019	7,499,049
2020	8,016,510
2021	7,603,474
2022	5,578,226

Source: NPS 2023l

Table 3-43 summarizes the total number of visits to LMNRA by visitor segment for 2022, the most recent year for which data are available.

Water quality concerns are increasing and are described in detail in **Section 3.8**. In the spring and summer of 2015, both Lake Mead and Lake Mohave experienced notable concentrations of harmful blue-green algae, which triggered harmful algal bloom advisories for various locations across the lakes (NPS 2023n). In 2022, a swimmer was fatally infected with a brain-eating amoeba (Naegleria fowleri) at Lake Mead. Brain-eating amoebas are commonly found in bodies of warm freshwater, such as lakes, rivers, and geothermal water (NPS 2022c). These trends may continue to increase as water temperatures warm.

Declining reservoir elevations at Lake Mead in recent years have exposed mudflats along several areas of the shoreline. These have created dangerous conditions where recreationists have periodically become stuck in wet, muddy deposits. Some of these areas have access roads that previously enabled visitors to drive close to the shoreline when reservoir elevations were higher. As

Table 3-43
Lake Mead National Recreation Area Visits by Visitor Segment for 2022

Recreation Visitors	Non-Recreation Visitors*	Concession Lodging	Tent Campers	RV Campers	Concession Camping	Backcountry Camping	Misc. Campers	Total Overnight Stays
5,578,226	202,320	28,256	43,138	54,901	226,803	28,747	48,949	430,793

Source: NPS 2023m

*The NPS defines reportable non-recreation visits to include:

- Persons going to and from inholdings across significant parts of park land
- Commuter and other through traffic using NPS-administered roads or waterways through a park for their convenience
- Tradespeople with business in the park
- Any civilian activity that is a part of or incidental to the pursuit of a gainful occupation (for example, guides)
- Government personnel (other than NPS employees) with business in the park
- Citizens using NPS buildings for civic or local government business, or attending public hearings
- Outside research activities (visits and overnights), if they are independent of NPS-legislated interests (for example, meteorological research) (NPS 2022a)

reservoir elevations have declined over recent years, visitors have often attempted to chase the shoreline both in their vehicles and by foot to gain access to the changing shoreline for such purposes as fishing, hiking, and other recreational activities. In doing so, they and their vehicles have become stuck in these muddy conditions, requiring assistance from NPS personnel and others to extract themselves and/or their vehicles.

Boating Facilities

LMNRA is considered one of the premier water-based recreation areas in the Nation. Most visitors participate in water-based recreational activities, primarily between May and September. These recreational activities are supported by marina and launch ramp facilities developed along the Lake Mead shoreline. On average, the majority of boats are personal watercraft. (Section 3.12.1.3 of the 2007 FEIS provides additional information on boating and shoreline public use facilities at LMNRA; the information is incorporated by reference.) **Table 3-44** shows critical elevations identified by the NPS for Lake Mead, below which marinas, boat docks, or boat launch ramps become inoperable.

Since the publication of the 2007 FEIS, the Echo Bay, Boulder Harbor, and South Cove boat ramps have closed due to low water levels. The NPS facilities at the Temple Bar Marina are also inoperable; however, the concessionaire launch operations remain operable. The Pearce Bay launch ramp, a take-out point for rafts and whitewater boats, previously closed at elevation 1,175 feet. Access to Lake Mead was closed at Pearce Ferry in 2001 when the water elevation dropped to 1,175 feet. In 2010, the NPS extended Pearce Ferry Road 2 miles to the Colorado River to provide for river take-out operations for private and commercial river runners (NPS 2010).

Table 3-44
Critical Elevations for Lake Mead by Boating Facility

Lake Elevation (feet)	Impact and Facility
1,221	Full pool
1,150	Las Vegas Bay and Government Wash public launch ramps closed
1,125	Overton Beach Marina, Calville Ramp, and South Cove Ramp closed
1,112	Lake Mead Marina – Relocation of "C Dock" to Hemenway
1,110	Overton public launch ramps closed
1,100	Lake Mead Marina must relocate out of the protected harbor
1,080	Lake Mead Marina public launch ramp closed; Hemenway public launch ramp closed; Temple Bar public launch ramp closed
1,050	Echo Bay public launch ramp closed

Source: Henderson 2006

Changes to water levels affect the usability of the remaining boat launch ramps throughout the year, especially in warmer months. Launch ramp closures resulting from declining water levels have resulted in longer lines, limited parking, and congestion at boat ramps and docks. In addition, ongoing maintenance and construction at ramps have resulted in temporary closures.

Hoover Dam to Davis Dam

Recreational opportunities available at Lake Mohave include boating, canoeing on northern parts of the lake, camping, exploring, fishing, photography, picnicking, swimming, parasailing, cliff diving (two locations), and water skiing. There are also hundreds of beaches that can only be accessed by boat. (The main shoreline access points and facilities for public use and boat launching for Lake Mohave are described in Section 3.12.1.4 in the 2007 FEIS; this information is incorporated by reference.)

Davis Dam to Parker Dam

The Davis Dam to Parker Dam reach includes several recreational areas along the Colorado River, including Laughlin, Bullhead City, Davis Camp, Needles, Havasu NWR, Lake Havasu State Park, and Bill Williams River NWR. (Relevant recreational areas are briefly described in Section 3.12.1.5 in the 2007 FEIS; the information is incorporated by reference.) Lake Havasu is the premier attraction area within the Davis Dam to Parker Dam reach. **Table 3-45** lists the visitation at Arizona's Lake Havasu and Cattail Cove State Parks.

Table 3-45
Visitation at Arizona's Lake Havasu and Cattail Cove State Parks

Year	Lake Havasu State Park Visitation	Cattail Cove State Park Visitation
2016	477,283	70,442
2017	519,704	106,545
2018	551,203	111,376
2019	488,597	111,262

Year	Lake Havasu State Park Visitation	Cattail Cove State Park Visitation
2020	598,403	116,822
2021	492,074	95,179

Source: Northern Arizona University 2022a, 2022b

Parker Dam to Cibola Gage

The Parker Dam to Cibola Gage reach includes several recreational areas, including Parker Strip Recreation Area, Palo Verde Diversion Dam, Blythe, and Cibola NWR. (Relevant recreational areas are briefly described in Section 3.12.1.6 in the 2007 FEIS; this information is incorporated by reference.)

Cibola Gage to Imperial Dam

The Cibola Gage to Imperial Dam reach includes a few recreational areas: Picacho State Recreation Area, Imperial NWR, and Martinez Lake. (Relevant recreational areas are briefly described in Section 3.12.1.7 in the 2007 FEIS; this information is incorporated by reference.)

Imperial Dam to NIB

The Imperial Dam to the NIB reach includes a few recreational areas along the Colorado River, including Betty's Kitchen and Mittry Lake Wildlife Area. (Relevant recreational areas are briefly described in Section 3.12.1.8 in the 2007 FEIS; the information is incorporated by reference.)

NIB to SIB

The NIB to the SIB reach includes shoreline public use facilities in the city of Yuma, Arizona. Typical water activities within this reach—which is located on the edge of the historical floodplain to the east of the Colorado River—include boating, swimming, and sport fishing.

Salton Sea

The Salton Sea is California's largest lake, and it contains approximately 130 miles of shoreline. The Salton Sea includes two primary recreation areas: the Salton Sea State Recreation Area and Sonny Bono Salton Sea NWR.

The Salton Sea State Recreation Area encompasses 14 miles of the northeastern shore and receives approximately 200,000 visitors annually (California Department of Parks and Recreation 2023a, 2023b). The season of peak use has typically been from October through May, when daytime temperatures are milder compared to summer months. Salton Sea State Recreation Area is a popular site for campers, boaters, and anglers. The Salton Sea has historically been stocked with sport fish; however, increasing salinity in the Salton Sea basin has reduced the number of fish species present, and most fish currently caught are tilapia. The area has five campgrounds with a total of 1,600 campsites, hundreds of day use sites, a boat ramp and wash area, trails, a visitor center (open during the peak season), a play area for children, and fishing jetties (California Department of Parks and Recreation 2023a).

The Sonny Bono Salton Sea NWR contains two separately managed units 18 miles apart. They are bordered by the Salton Sea on the north and by farmlands on the east, south, and west (Service 2023). The refuge provides visitors with unique opportunities for hunting, fishing, hiking, and

educational programs. The Sonny Bono Salton Sea NWR contains a visitor center and headquarters, self-guided trails, an observation tower, and picnic areas (Service 2023).

Reservoir Boating

Reservoir boating is affected by fluctuating reservoir elevations; these fluctuations specifically cause changes in exposure to boating navigation hazards and changes in safe boating capacities. Hazards such as exposed rocks may become more evident, and changes in navigation patterns may be necessary as reservoir elevations decline. At low-pool elevations, special buoys or markers may be placed within reservoirs to warn boaters of navigation hazards. In addition, signs may be placed in areas that are deemed unsuitable for navigation.

Lake Powell

The navigation system on Lake Powell utilizes regulatory buoys and other marking devices to warn boat operators of hazardous conditions associated with subsurface obstructions or changes in subsurface conditions that could be hazardous for safe passage. Section 3.12.2.1 of the 2007 FEIS describes safe boating navigation and safe boating capacity on Lake Powell; the information is incorporated by reference. Placement of many of these marking devices depends on the lake elevation. Recreational boating is the most frequent type of boating activity on Lake Powell. One of the most popular activities at Lake Powell is taking out houseboats and motorboats for multiple day excursions to explore the reservoir. As the pool elevation decreases, the surface area suitable for boats as well as navigability also decreases. Since the pool elevation has decreased since the publication of the 2007 FEIS, the safe boating capacity at Lake Powell has subsequently decreased.

Thousands of adult quagga mussels have been found at Lake Powell attached to canyon walls, Glen Canyon Dam, boats, and other underwater structures. Quaggas rapidly multiply, are easy to spread, and encrust and clog boat engines, shorelines, and anywhere else conducive to their growth. These impacts are particularly prevalent in the southern portions of the reservoir. Adult mussel populations are expected to expand and increase over the next few years (NPS 2023n).

Lake Mead

Regulatory buoys and other marking devices are used on Lake Mead to warn boat operators of dangers, obstructions, and changes in subsurface conditions in the main channel or side channels. (Section 3.12.2.2 of the 2007 FEIS describes safe boating navigation and safe boating capacity on Lake Mead; this information is incorporated by reference.) Since the publication of the 2007 FEIS, the NPS has extended the Pearce Ferry launch ramp to provide river take-out operations for private and commercial river runners. However, due to the close proximity of the developing Pearce Ferry Rapid, the public launch of boats is prohibited (NPS 2010). Since the pool elevation has decreased since the publication of the 2007 FEIS, the safe boating capacity at Lake Mead has subsequently decreased.

Lake Mohave and Lake Havasu

Because Lake Mohave and Lake Havasu will continue to be operated to meet monthly target elevations, reservoir boating safe navigation and capacity in these reaches will not be affected by the proposed alternatives.

River and Whitewater Boating

Whitewater boating is the key recreational activity in the Grand Canyon from Lees Ferry to the Diamond Creek or Pearce Ferry takeouts. Other reaches are not predominantly whitewater localities; therefore, they will not be discussed in this section.

Glen Canyon Dam to Lake Mead

Grand Canyon river trips launch at Lees Ferry in GCNRA and take out at Diamond Creek on the Hualapai Indian Reservation or at Pearce Ferry in LMNRA. River trips are conducted using a variety of types and sizes of boats and rafts; group sizes can range up to 32 people (including guides). Trip lengths range up to 25 days and can be run by commercial companies or by private individuals. There are various means of joining trips, including launching from Lees Ferry, hiking into or out of the canyon to join and leave a trip, and gaining limited access by vehicle and helicopter (commercial use only) to join trips in the western portion of the Grand Canyon.

GCNP regulates recreational boating in accordance with the CRMP (NPS 2006a). The CRMP prescribes management of recreational use by establishing limits on the number of daily launches, group size, trip length, and motorized and nonmotorized use periods. In general, whitewater navigability can be affected by lower flows and by large amounts of side canyon debris that gets washed into the river channel. Because of these factors and reduced water levels, Separation Rapid is now visible, and it is consequentially more difficult to navigate. As Lake Mead has receded, the Colorado River has scoured a new channel in the silts deposited by the waters of Lake Mead. While most of the river still follows the old river channel, a new channel has developed near Pearce Ferry, creating a new impassible (going upstream) class VI rapid known as the Pearce Ferry Rapid (Joel 2016). Intermittent, larger-volume and higher-magnitude flows could improve navigability at some of these rapids.

Hoover Dam to SIB

The proposed alternatives are not expected to adversely affect river and whitewater boating between Hoover Dam and the SIB.

Sport Fishing

There are no specific reservoir elevation thresholds or river stages related to sport fishing identified from the literature reviewed. Catch rates for reservoir fishing are assumed to be directly related to reservoir habitat. Fishing satisfaction is assumed to be directly related to 1) the general recreation issues of boating access to water via shoreline facilities, and 2) the boating navigation potential for hazards or reservoir detours due to low reservoir elevations.

Lake Powell and Glen Canyon Dam

Lake Powell supports a popular warmwater sport fishery composed mainly of striped and smallmouth bass. The striped bass depend on threadfin shad for a significant portion of their diet. The threadfin shad in Lake Powell are at the northernmost portion of their range, and they are sensitive to fluctuations in water temperature. Gizzard shad may become an important striped bass forage fish. In addition to striped and smallmouth bass, Lake Powell supports largemouth bass, walleye, channel catfish, bluegill, and black crappie. Angler use in 2018 was at a 40-year low, mainly

attributed to a decline in the percentage of boat days that were spent angling (Blommer and Gustaveson 2021).

Glen Canyon Dam to Lake Mead

The 15.5-mile Glen Canyon reach of the Colorado River supports a Blue Ribbon recreational rainbow trout fishery that attracts local, national, and international anglers. The NPS, in coordination with the Arizona Game and Fish Department and the Service, manages fish in all waters within the GCNRA and GCNP. The intention of Blue Ribbon management is to provide a quality fishing opportunity where anglers can catch larger-than-average trout, at a relatively high catch rate, in a unique recreational setting. Most angling is done from boats or is facilitated by boat access, often provided by guide services. Some anglers also wade or fish from shore.

Fishing in the Glen Canyon reach occurs year-round. Peak usage is in April and May; however, substantial fishing has occurred from March through October in most years (Rogowski and Boyer 2020). An estimated total of 7,654 anglers used the rainbow trout fishery in 2019; of these, 5,469 were boat anglers and 2,185 were walk-in anglers (Rogowski and Boyer 2020).

Section 3.13.1 provides further information on rainbow trout dynamics in the Glen Canyon reach.

Lake Mead and Hoover Dam

Lake Mead has an excellent warmwater sport fishery composed of largemouth bass, striped bass, channel catfish, rainbow trout, bullhead catfish, sunfish, crappie, and bluegill. The majority of the catch consists of striped bass. Fishing is generally better in the fall months of September, October, and November. Larger fish are caught by deepwater trolling in spring from March through May.

The Lake Mead Fish Hatchery, operated by the Nevada Department of Wildlife (NDOW), historically raised rainbow trout, endangered razorback suckers, and bonytail chub. Since the publication of the 2007 FEIS, the Lake Mead Fish Hatchery ceased operations in 2022 in response to Lake Mead declining below 1,060 feet, the point at which the hatchery drew its water (Peterson 2022). The NDOW and SNWA are currently developing a project to replace the hatchery's water supply line to draw deeper in the water column.

Hoover Dam to Davis Dam

Lake Mohave's fishery is similar to Lake Mead's fishery. In Lake Mohave, there are largemouth bass, striped bass, channel catfish, rainbow trout, bullhead catfish, sunfish, crappie, and bluegill. Largemouth and striped bass are in deep water in the winter and move into shallow water to spawn in the spring. Fishing is open year-round, but the best fishing generally occurs in September, October, and November. For deepwater trolling, March through May tends to provide the best conditions.

Davis Dam to Parker Dam

Striped bass is the dominant sport fish in Lake Havasu. They can be caught throughout the year, but the best fishing locations change with the seasons and with water temperature. The largemouth bass population supports tournaments nearly every weekend from September through May. The smallmouth bass population has experienced an increase in numbers over the past couple of years. Channel catfish are abundant and average 2 to 4 pounds in size. Flathead catfish grow to large sizes

in Lake Havasu. Only a limited number of anglers fish specifically for catfish. Black crappie numbers are limited due to overharvesting and a lack of habitat.

Parker Dam to SIB

Fishing in Cibola NWR is limited to certain times of the year. Cibola NWR is managed to protect wintering waterfowl that use Cibola Lake. The lake is closed to fishing from Labor Day to March 15. Sport fishing in Cibola Lake includes largemouth, smallmouth, and striped bass; channel and flathead catfish; crappie; sunfish; tilapia; and common carp.

The Imperial NWR is managed as a refuge and breeding area for migratory birds and other wildlife. Hunting and fishing are permitted in some areas, according to state regulations, and fishing by boat is allowed in the mainstream Colorado River any time of the year.

3.14.2 Environmental Consequences

Methodology

This section examines the potential effects of the No Action Alternative and the Proposed Action on recreation within the analysis area. Reclamation's CRMMS modeling results helped develop potential releases, reservoir elevations, and flow rates from the alternatives. The results of these analyses are used throughout this section.

Method Used to Assess Shoreline Public Use Facilities

This section analyzes the impacts that reservoir elevations decreasing below critical thresholds would have for using selected marinas, boat docks, and launch ramps, as well as whether these elevations could impact access to or use of attraction features. (Threshold reservoir elevations were determined using the methodology in the 2007 FEIS.) The threshold elevations were used as indicators of recreational facilities that might be rendered inoperable or that might require relocation or modification to maintain their operation. **Figure 3-5** provides the projections of reservoir elevations for 2024, 2025, and 2026 (the end of the interim period). The narrative of the alternatives' effects is provided below for selected facilities at both Lake Powell and Lake Mead. These facilities are representative of the alternatives' potential effects on shoreline recreational opportunities at each reservoir.

Method Used to Assess Reservoir Boating and Navigation Hazards

This analysis assesses the impacts of reservoir elevations decreasing below critical thresholds, which would result in boating navigation hazards and changing navigable areas and passageways. It also assesses whether corresponding decreases in reservoir surface areas might affect safe boating capacities. (Threshold pool elevations were determined using the methodology identified in the 2007 FEIS.)

Method Used to Assess Whitewater Boating

This analysis uses river flow data from **Section 3.6** to analyze whether there would be increased exposures to boating navigation hazards, changes in access or use of rest areas and take-outs, or changes in trip durations resulting under the Proposed Action, as compared with the No Action Alternative. (Threshold river flows were determined using the methodology identified in the 2007

FEIS.) Whitewater boating is the key recreational activity in the Grand Canyon downstream of Lees Ferry and upstream of Lake Mead. The 2007 FEIS analysis also includes a discussion of areas on the Colorado River that could become unsafe for whitewater boating at certain flows due to hazards such as exposed rocks, changes in navigation patterns caused by obstructions, and increased or decreased flow velocities. These flows were also analyzed to determine elevations at or below which various whitewater boating facilities (rest areas and take-out points) might be rendered inoperable or require modification to maintain their operation.

Method Used to Assess Sport Fishing

This analysis evaluates changes in sport fishing opportunities by river reach under the Proposed Action as compared with the No Action Alternative. The assessment of sport fishing was based on a literature review to determine the current status of fish assemblages in the analysis area. No specific reservoir elevation thresholds related to sport fishing were found. A general discussion about changes in flow and salinity and possible effects on sport fish is also provided.

A more detailed analysis of effects on rainbow trout based on changes in water temperature is used for the Colorado River reach between Glen Canyon Dam and Lake Mead. Water temperature changes may affect sport fish. Rainbow trout were chosen for the analysis based on the importance of their recreational fishery in the Colorado River reach below Glen Canyon Dam.

Striped bass and threadfin shad in Lake Powell and Lake Mead were selected to represent the reservoir sport fishery; striped bass are a sport fish, and threadfin shad are their food source.

Assumptions

In addition to being consistent with the modeling assumptions, this analysis assumes that recreation in the impact analysis area will increase over time, provided dead pool is not reached.

Impact Indicators

- Threshold reservoir elevations
- Threshold river flows
- Water temperatures
- Rainbow trout water temperature thresholds
- Striped bass and threadfin shad populations

Issue 1: How would reduced reservoir levels impact recreation at Lake Powell?

Section 3.14.1, **Table 3-39** identifies the threshold elevations below which shoreline recreational facilities at Lake Powell could be affected**.** Below these elevations, facility adjustments or capital improvements would be required, creating potential impacts on recreation at Lake Powell.

Summary

Under both the No Action Alternative and the Proposed Action, projected Lake Powell elevations for much of the analysis period would be below the critical thresholds for most boat launch facilities and for safely navigating Castle Rock and Gregory Butte. This would result in a reduction in the quality of or the loss of reservoir boating opportunities on Lake Powell. Under both alternatives,

dock access would continue to be unavailable from the Rainbow Bridge National Monument shoreline, which would continue until a long-term access solution was developed.

Under both alternatives, impacts on public health resulting from harmful algal blooms would likely increase as lake elevations decline. Under both alternatives, declining reservoir elevations would expose additional areas of Glen Canyon that were previously inundated by Lake Powell. This would continue to create new visitation patterns and resource protection challenges due to access to new areas, as described in the affected environment. Both alternatives are not expected to significantly impact sport fish populations. Recreation impacts at Lake Powell would be slightly reduced under the Proposed Action because the Proposed Action would preserve more water in Lake Powell and reduce overall variability in water surface elevations.

No Action Alternative

Boat Launch Facilities

Under the No Action Alternative, the median modeled Lake Powell elevations start at a minimum monthly elevation of 3,561 feet in 2024 and end at a maximum monthly elevation of 3,605 feet in 2026. The median modeled Lake Powell elevation (3,561 feet) is below the critical threshold for all Lake Powell boat launch facilities, which would necessitate they be closed or relocated. If the median 2024 projected Lake Powell elevation were to be reached before a launch ramp at Stanton Creek area is developed, then Lake Powell would be unable to provide reservoir boating opportunities. The ability for boat launch access to continue under the No Action Alternative would depend on how quickly new boat launch facilities were constructed.

Safe Boating Capacities and Exposure to Navigation Hazards

In general, as reservoir elevations drop, hazards such as submerged snags and boulders can become exposed or become closer to the surface, increasing the likelihood that boats can come in contact with them. The elevations of such hazards are often unknown until the hazards become exposed. At a Lake Powell elevation of 3,620 feet, hazardous obstructions result in boating being prohibited around Castle Rock and Gregory Butte. Under the No Action Alternative, the median 2024 projected Lake Powell elevation is below this threshold, which would result in boating restrictions around Castle Rock and Gregory Butte. These restrictions would likely be in place throughout the analysis period, unless the upper projections for 2026 (3,686 feet) were reached.

Access or Use of Rainbow Bridge

Under the No Action Alternative, dock access would continue to be unavailable from the Rainbow Bridge National Monument shoreline. Access would continue to be limited to the Rainbow Bridge Trail. Boat and small vessel shoreline access would likely become more difficult to impossible as pool elevations decrease. These impacts would continue until long-term access solution was developed.

Harmful Algal Blooms

Under the No Action Alternative, reduced reservoir elevations could create conditions that would be more conducive to the growth of harmful algal blooms. Harmful algal blooms may increasingly pose serious health risks to humans and animals. (Water quality concerns are described in detail in **Section 3.8**.)

Lake Powell Sport Fish Populations

Under the No Action Alternative, the maximum lethal limits of 37°C and 33°C for threadfin shad and striped bass, respectively, would not be exceeded. These water temperatures are for the upper 10 feet of the reservoir; lower depths provide cooler water. Striped bass and threadfin shad would be able to move into the cooler thermocline during the summer months. Under the No Action Alternative, water temperatures would not drop below the lower lethal limit of 5°C for striped bass or threadfin shad. Because surface temperatures would not exceed the lethal tolerances of either species, and it is assumed that both species would have adequate thermal refugia, substantial temperature-related impacts on the reservoir sport fishery are not anticipated to occur under the No Action Alternative.

Proposed Action

In general, impacts on recreation under the Proposed Action would be similar to those described under the No Action Alternative. Impacts on recreation under the Proposed Action that differ from the No Action Alternative are presented below.

Boat Launch Facilities

Under the Proposed Action, the median of Lake Powell monthly pool elevations would range from a minimum of 3,562 feet in 2024 to a maximum of 3,603 feet in 2026. Similar to the No Action Alternative, the median projected monthly Lake Powell elevations would be below the critical threshold for all Lake Powell boat launch facilities, which would result in impacts similar to those described under the No Action Alternative. Projected Lake Powell elevations under the No Action Alternative and Proposed Action would be similar until August 2025, when the range of the No Action Alternative cloud drops below the Proposed Action. The maximum projected 2025 pool elevation under the Proposed Action (3,640 feet) would be higher than under the No Action Alternative, which would increase the likelihood that the Wahweap Marina, Antelope Point Marina, Bullfrog Marina, and Halls Crossing Marina would remain operable. This would slightly reduce the impacts on boat launch facilities under the Proposed Action, as compared with the No Action Alternative.

Cumulative Effects

The operating tiers established by this SEIS will determine annual release volumes in the LTEMP SEIS. The LTEMP SEIS includes two elements: smallmouth bass flow options and a potential adjustment to HFE sediment account periods and implementation windows. The smallmouth bass flow options would result in temporary changes to daily and hourly flows, which would not impact reservoir levels. Therefore, the potential change of smallmouth bass flow options would result in no changes to annual or monthly reservoir levels in Lake Powell. The potential adjustment to HFE sediment accounting periods and implementation windows could result in changes in the timing of HFEs, which could minimally affect monthly reservoir levels in Lake Powell. These differences are expected to be minor, temporary, and resolved by the end of the operating year and would result in no changes to annual reservoir levels in Lake Powell. Therefore, minimal cumulative effects would occur on reservoir levels due to proposed operational changes evaluated in the LTEMP SEIS. The potential change included in the LTEMP SEIS flow options would result in no changes to annual or monthly reservoir levels in Lake Powell. Therefore, proposed operational changes evaluated in the LTEMP SEIS would not cumulatively affect recreation on Lake Powell.

No cumulative effects would occur on recreation due to the proposed management activities planned in the Salton Sea 10-Year Plan or the environmental assessment for the implementation of the 10-Year Plan's projects. No cumulative impacts would result as the Proposed Action is not adding additional impacts to those that are already occurring; however, these impacts might occur sooner under the Proposed Action.

Issue 2: How would reduced flows downstream of Lake Powell affect recreation from Glen Canyon Dam to Lake Mead?

Summary

Under both alternatives, daytime flows would not drop lower than the safe whitewater boating threshold of 5,000 cfs. Therefore, there would be no change in exposure to unsafe boating conditions caused by changes in river levels. Under both alternatives, lethal limits for rainbow trout are not projected to be exceeded in any month throughout the analysis period. As seen in **Figure 3-37**, release temperatures are predicted to exceed 20°C during the 2026 summer period under the No Action Alternative, but temperatures are not predicted to exceed this threshold in any year under the Proposed Action. If temperatures were to reach or exceed 23°C, this could result in adverse impacts on rainbow trout growth, which would negatively impact the rainbow trout fishery in the Glen Canyon reach. Warmer water temperatures will not reach lethal limits for the native fishes, which are all warmwater species and can tolerate water temperatures of over 30°C (Bulkley et al. 1982).

No Action Alternative

Boating

Current operation of Glen Canyon Dam under the LTEMP SEIS and ROD requires a minimum flow release of 8,000 cfs between 7:00 a.m. and 7:00 p.m. and 5,000 cfs at night. Boating safety was among the issues considered and addressed in developing the minimum flows. Because compliance with the minimum release will continue under the No Action Alternative, daytime flows would not drop lower than the safe whitewater boating threshold of 8,000 cfs. Releases from Glen Canyon Dam would generally be higher than these minimum flows. Therefore, there would be no change in exposure to unsafe boating conditions caused by changes in river levels. Minor changes in exposure to boating navigation hazards caused by a change in river velocity, changes in access or use of rest areas and take-out points, changes in trip duration caused by changes in river velocity, or changes in the ability to use sport fishing sites caused by a change in flows may occur under the No Action Alternative. These changes would not be substantial, and they would not significantly affect recreational boating use or opportunities.

However, under the No Action Alternative, Lake Powell would be more likely to decrease below minimum power pool (3,490 feet). If Lake Powell were to reach minimum power pool, it would likely result in lower releases that could have the potential to create unsafe whitewater boating conditions in the Grand Canyon.

Releases from Glen Canyon Dam throughout the analysis period have the potential to be below the threshold to produce HFEs, which would result in reduced sandbar building. In the long term, this would negatively impact the availability of campsites for boaters in the Grand Canyon. See **Section 3.8.2** for further details on the impacts on sandbar building.

As analyzed in the LTEMP FEIS and ROD, a slight increase (2 percent) in suspended sediment would occur at Hualapai recreational facilities in the western Grand Canyon when HFEs are implemented (Reclamation and NPS 2016). The probability of triggering HFEs under the alternatives is described in **Section 3.8.2**, under Issue 3. Reclamation would address any concerns related to these facilities in the manner stated in the 2012 letter between Reclamation and the Hualapai Tribe (Walkoviak 2012; Reclamation and NPS 2016).

Sport Fish Populations

Water temperatures above 21°C have the highest potential to affect spawning, incubation, growth, and mortality of rainbow trout. Temperatures 23°C and above have the potential to stop growth, and temperatures 25°C and above are known to be lethal (FAO 2023). Under the No Action Alternative, water temperatures are projected to exceed 20°C during the 2026 summer period (**Figure 3-37**). Under the No Action Alternative, lethal limits for rainbow trout are not projected to be exceeded in any month. See **Section 3.13.2** for further details on the impacts on fish species.

Proposed Action

Boating

Under the Proposed Action, daytime flows would not drop lower than the safe whitewater boating threshold of 8,000 cfs. Therefore, impacts on whitewater boating would be similar to those described under the No Action Alternative (assuming power pool conditions are not reached under the No Action Alternative).

Sport Fish Populations

Under the Proposed Action, there would be slightly more days above the 16°C (60.8°F) threshold on average in operating years 2024 and 2025; however, the Proposed Action would exceed the 16°C (60.8°F) threshold on fewer days in operating year 2026 compared with the No Action Alternative (**Figure 3-35**). This could lead to greater physiological stress on rainbow trout under warmer conditions. There are no predicted periods of temperatures exceeding the 20°C threshold under the Proposed Action. Overall, the impacts on the rainbow trout fishery would be similar to those described under the No Action Alternative.

Cumulative Effects

The LTEMP SEIS flow options would likely have a cumulative impact on the rainbow trout sport fishery within the Glen Canyon Dam to Lake Mead reach of the Colorado River due to changes in the water temperature released from Glen Canyon Dam. Reducing water temperatures to prevent smallmouth bass establishment would benefit rainbow trout by reducing water temperatures to a range conducive to rainbow trout, aerating the water, and limiting the potential for smallmouth bass establishment. Under both alternatives, the effects of this cumulative action would be beneficial to rainbow trout, unless water levels in Lake Powell reached minimum power pool levels. At this elevation, all flows passing through Glen Canyon Dam would be directed through the river outlet works out of necessity, nullifying this cumulative action.

If the LTEMP SEIS flow options were not implemented, the Proposed Action may result in poorer outcomes for rainbow trout due to increased water temperatures, predation from smallmouth bass,

increased entrainment of nonnative fish species, and lower dissolved oxygen when the dam would be operated near 3,500 feet. These dynamics are further described in **Section 3.13.2**.

No cumulative effects would occur on recreation due to the proposed management activities planned in the Salton Sea 10-Year Plan or the environmental assessment for the implementation of the 10-Year Plan's projects. No cumulative impacts would result as the Proposed Action is not adding additional impacts to those that are already occurring; however, these impacts might occur sooner under the Proposed Action.

Issue 3: How would reduced reservoir levels impact recreation at Lake Mead?

Section 3.14.1, **Table 3-44** identifies the threshold elevations below which shoreline recreational facilities at Lake Mead could be affected. Facility adjustments or capital improvements would be required below these elevations, creating potential impacts on recreation at Lake Mead.

Summary

Under the No Action Alternative, the highest median projected Lake Mead elevation is below the critical threshold to allow access at all Lake Mead boat launch facilities except the Pearce Ferry Road launch ramp (used only for takeout). This would necessitate closing the boat launch facilities or relocating them throughout the entire analysis period. The slight increase in Lake Mead elevations under the Proposed Action could marginally help limit the closure or relocation of boat launch facilities at Lake Mead in 2026, compared with the No Action Alternative. Additionally, under both alternatives, the projected median elevation for Lake Mead would be at a level at which boaters are likely to encounter boating navigational hazards. Under both alternatives, projected surface water temperatures at Lake Mead are not anticipated to impact sport fish.

No Action Alternative

Access or Use of Lake Mead Boating Facilities

Under the No Action Alternative, the highest median projected Lake Mead elevation (1,056 feet) is below the critical threshold for all Lake Mead boat launch facilities except the Pearce Ferry Road launch ramp (used only for takeout). This would necessitate closing the boat launch facilities or relocating them throughout the entire analysis period. Launch ramp closures resulting from declining water levels would result in longer lines, limited parking, congestion at boat ramps and docks, and the potential loss of most facilities. Declining water levels would also likely continue to contribute to public safety concerns as recreationists attempt to navigate through exposed mudflats to access shoreline recreation opportunities, as described under **Section 3.14.1**.

Safe Boating and Navigation Hazards

Over the years, sediment has built up in the section of the reservoir between Grand Wash Cliffs and Pearce Ferry. When Lake Mead's elevation drops below 1,170 feet, there is no well-defined river channel in this upper portion of Lake Mead, making it dangerous for boaters (NPS 2006a). In general, as reservoir elevations drop, hazards such as submerged snags and boulders can become exposed or become closer to the surface, increasing the likelihood that boats can come in contact with them. The elevations of such hazards are often unknown until the hazards become exposed. Under the No Action Alternative, the projected median pool elevation for Lake Mead would be

below 1,170 feet throughout the period of analysis, which would result in boaters encountering navigational hazards in upper Lake Mead.

Sport Fish Populations
The effects of water temperatures on striped bass and threadfin shad in Lake Powell are expected to be similar at Lake Mead. However, threadfin shad are near the northern limit of their range at Lake Powell. Threadfin shad are less likely to be affected by cold winter temperatures at Lake Mead.

Proposed Action

Access or Use of Lake Mead Boating Facilities
Under the Proposed Action, the 2024 median projected Lake Mead elevation would be below the critical threshold for all Lake Mead boating facilities except for the Pearce Ferry Road launch ramp (used only for takeout); therefore, the impacts on boating facilities would be similar to those described under the No Action Alternative for 2024. While the 2026 median pool elevation projection (1,067 feet) remains below the critical threshold for access for most Lake Mead boating facilities, the upper range of projections for 2026 could enable the Echo Bay public launch ramp to reopen, unlike under the No Action Alternative. Overall, the slight rebound in Lake Mead elevations under the Proposed Action could marginally help limit the closure or relocation of boat launch facilities and public safety risks due to shoreline access at Lake Mead in 2026 compared with the No Action Alternative.

Safe Boating and Navigation Hazards
Under the Proposed Action, the projected median pool elevation for Lake Mead would be below 1,170 feet throughout the period of analysis, which would result in boating navigational hazards similar to those described under the No Action Alternative. These impacts could be slightly reduced in 2025 and 2026 due to the slightly higher Lake Mead pool elevations under the Proposed Action, as compared with the No Action Alternative.

Sport Fish Populations
Impacts on sport fish populations would be similar to those described under the No Action Alternative.

Cumulative Effects

As with Lake Powell, minimal cumulative effects would occur on reservoir levels due to proposed operational changes evaluated in the LTEMP SEIS. Therefore, the LTEMP SEIS flow options would not cumulatively affect recreation at Lake Mead.

No cumulative effects would occur on recreation due to the proposed management activities planned in the Salton Sea 10-Year Plan or the environmental assessment for the implementation of the 10-Year Plan's projects. No cumulative impacts would result as the Proposed Action is not adding additional impacts to those that are already occurring; however, these impacts might occur sooner under the Proposed Action.

Issue 4: How would reduced flows downstream of Lake Powell affect recreation from Hoover Dam to the Salton Sea?

Summary

Under both alternatives, flow releases from Hoover Dam, Davis Dam, Parker Dam, and Imperial Dam would all be within the historical operating range. Therefore, there would be minimal changes in exposure to boating navigation hazards caused by changes in the river's elevation, changes in exposure to boating navigation hazards caused by changes in the river's velocity, changes in access or use of rest areas and take-out points, changes in trip duration caused by changes in the river's velocity, or decreases in access or use of sport fishing sites caused by changes in flows. The sport fishery in this reach is primarily in warm water. The minor changes in water temperatures that may occur downstream of Hoover Dam would not be expected to affect warmwater sport fish. The current shoreline area of the Salton Sea could continue to decrease, resulting in similar impacts on shoreline recreation as described under the affected environment.

No Action Alternative

Under the No Action Alternative, flow releases from Hoover Dam, Davis Dam, Parker Dam, and Imperial Dam would all be within the historical operating range. Therefore, there would be minimal changes in exposure to boating navigation hazards caused by changes in the river's elevation, changes in exposure to boating navigation hazards caused by the changes in the river's velocity, changes in access or use of rest areas and take-out points, changes in trip duration caused by changes in the river's velocity, or decreases in access or use of sport fishing sites caused by changes in flows. The sport fishery in this reach is primarily in warm water. The minor changes in water temperature that may occur downstream of Hoover Dam would not be expected to affect warmwater sport fish. Under the No Action Alternative, the Salton Sea shoreline would continue to decrease at the current rate. Incremental increases in the exposed lakebed would make boat launches increasingly difficult, which could adversely affect this type of use on the Salton Sea. Increasing salinity could also affect the persistence of sport fish. This impact is not expected to be significant, however, as most fish currently caught are tilapia, a species that has a high salinity tolerance.

Proposed Action

Under the Proposed Action, impacts on recreation from Hoover Dam to the SIB would be the same as those described under the No Action Alternative. Under the Proposed Action, there is the possibility that IID and CVWD could take additional shortages, which could reduce river flows and inflow to the Salton Sea from irrigation drainage. This could diminish the Salton Sea shoreline more than the No Action Alternative would, thereby adversely affecting shoreline recreation, boating, and fishing as described under the No Action Alternative, but to a greater extent.

Cumulative Effects

The LTEMP SEIS flow options would not result in changes to reservoir releases from Glen Canyon Dam (Lake Powell) or Hoover Dam (Lake Mead); thus, they would not cumulatively affect recreation from Hoover Dam to the Salton Sea. The Salton Sea 10-Year Plan and the environmental assessment for the implementation of the 10-Year Plan's projects would partially temper the impacts on recreation described under the alternatives if they are successfully implemented.

3.15 Electrical Power Resources

3.15.1 Affected Environment

This section provides an overview of electrical power (that is, hydropower) generation, power marketing, and the Colorado River Basin federal accounts (i.e. Basin Fund) used to manage electrical power revenues and expenditure requirements for mainstream Colorado River dams. The 2007 Interim Guidelines describe in detail the electrical power resources that occur within the Colorado River Basin and within the analysis area. This section analyzes the same resources as the 2007 Interim Guidelines and provides updated information, data, and conditions since the publication of the 2007 Interim Guidelines (Reclamation 2007). The electrical power resources analyzed are as follows:

- Amount of electrical power generation and capacity
- Economic value of electrical power produced
- Electrical power-related contributions to the different Colorado River Basin federal accounts and programs supported by these funds

Overview

The primary power resources affected by the proposed alternatives include the Glen Canyon Powerplant, Hoover Powerplant, and Parker-Davis Project Powerplants. Other smaller facilities along the river include Headgate Rock Powerplant, Senator Wash, Siphon Drop, and Pilot Knob. Reclamation is responsible for the operation and maintenance of Glen Canyon, Hoover, Parker, and Davis facilities. WAPA is responsible for marketing and transmitting the power across the Upper and Lower Basins (Reclamation 2007).

Hydropower Generation

Hydropower generation occurs when water stored in a reservoir passes through a turbine located on a generating unit. The amount of power generated is directly related to the amount of water passing through the turbines and the elevation of the reservoir. The depth of the reservoir controls the force, or head (that is, the pressure caused by a difference in water depth—in this case, the difference between the lake reservoir elevation and the hydroelectric generators), the water has when moving through the turbines. Hydropower generation has two main measurable components: energy, which is the amount of power generation that occurs over time and is measured in MWh, and capacity, which is the maximum amount of energy that can be produced instantaneously and is measured in megawatts (MW).

Energy is mainly affected by the amount of water that passes through the generators and the depth of the reservoir. The higher the reservoir elevation, the more force, or head, the water can exert when passing through the turbines. Capacity is mainly affected by the depth of the reservoir and the availability of generators. Additional information on power generation, control, regulation, reserves, and ramping can be found in 2007 FEIS Section 3.11.1.1 (Reclamation 2007); the information is incorporated by reference.

There have been no changes to the manner in which hydropower is generated since 2007. However, regulations such as the LTEMP have led to changes in typical operations. In addition, recent drought conditions in the Basin have led to a substantial decrease in hydropower generation since the 2007 Interim Guidelines (Reclamation 2021d). Changes in hydropower generation are described in the powerplant-specific subsections below.

Power Marketing

WAPA markets and administers power contracts for electricity generated from Reclamation-owned and -operated hydropower projects (that is, Glen Canyon, Hoover, Parker, Davis, and the smaller generation projects). The BIA administers Headgate Rock Powerplant.

WAPA markets energy and capacity to its customers. Power marketing comes in two terms: 1) firm—or guaranteed to be available—capacity and energy; and 2) nonfirm, which only includes charges for energy delivered. Firm and nonfirm contracts can be short or long term. The majority of Colorado River Storage Project (CRSP) power is sold under long-term, firm contracts. Customers can purchase firm and nonfirm power through contracts with individual hydropower projects. Contracts for the Hoover Powerplant have been re-signed since the 2007 Interim Guidelines. Contracts for Parker-Davis Project were signed before the 2007 Interim Guidelines and terminate in 2028. It is expected new contracts will be signed to replace the expiring contract. The contract for Glen Canyon Dam terminates in 2024, and new contracts effective 2024 through 2057 have been executed with nearly identical terms and conditions (Reclamation 2021d).

Table 3-46 shows the total generation capability of each Western Electricity Coordinating Council (WECC) area. These WECC areas cover the entire Upper and Lower Colorado River Basins. Glen Canyon, Hoover, Parker, and Davis Powerplants account for approximately 2.2 percent of the total capacity.

Table 3-46
Generation Capability in WECC Areas

WECC Area	Available Capacity (MW)
Rocky Mountain Region	34,053.99
Southwest Region	45,483.61
California-Mexico Region	89,925.74

Source: WECC 2023

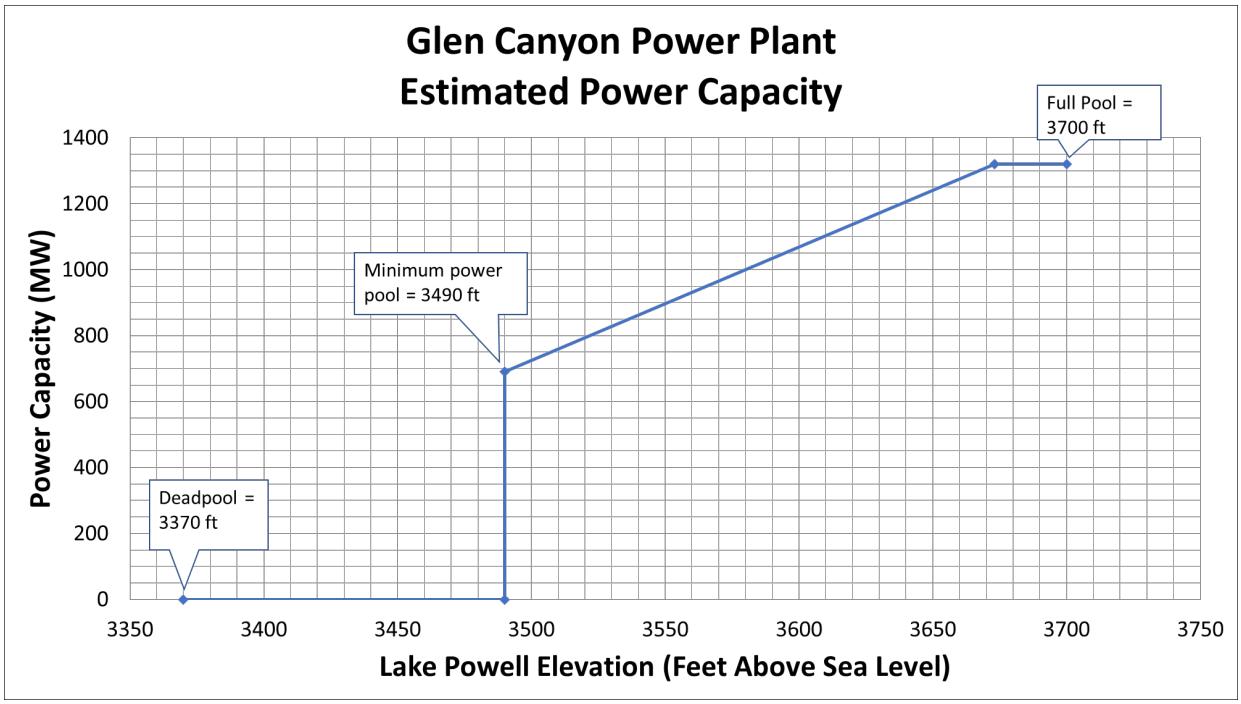
Lake Powell and Glen Canyon Dam

The Glen Canyon Powerplant accounts for approximately 75 percent of the Upper Colorado Basin's annual energy production (Reclamation 2021d). Since the 2007 Interim Guidelines were published, the powerplant has undergone projects to improve efficiency, including replacement of all eight turbines (Reclamation 2004b). Reclamation also optimized software within the facility, resulting in higher efficiency. Standard operations and maintenance work also have continued throughout this time (Reclamation 2021d).

Despite the improved efficiency, Glen Canyon Powerplant's capacity to generate power decreases as the lake elevation drops. **Figure 3-46** shows the estimated capacity at a range of lower lake elevations. This "plant" capacity is calculated from lake elevations and does not take into account the operating constraints. The modeled data in the environmental consequences section is "marketable" capacity, which considers both lake elevation and operating constraints. A discussion on modeled capacity is provided below. This decrease in elevation, and therefore head, has been the primary mechanism of reduced power generation since 2007. At minimum power pool (elevation 3,490 feet), the powerplant has an estimated capacity of 630 MW (Reclamation 2021d).

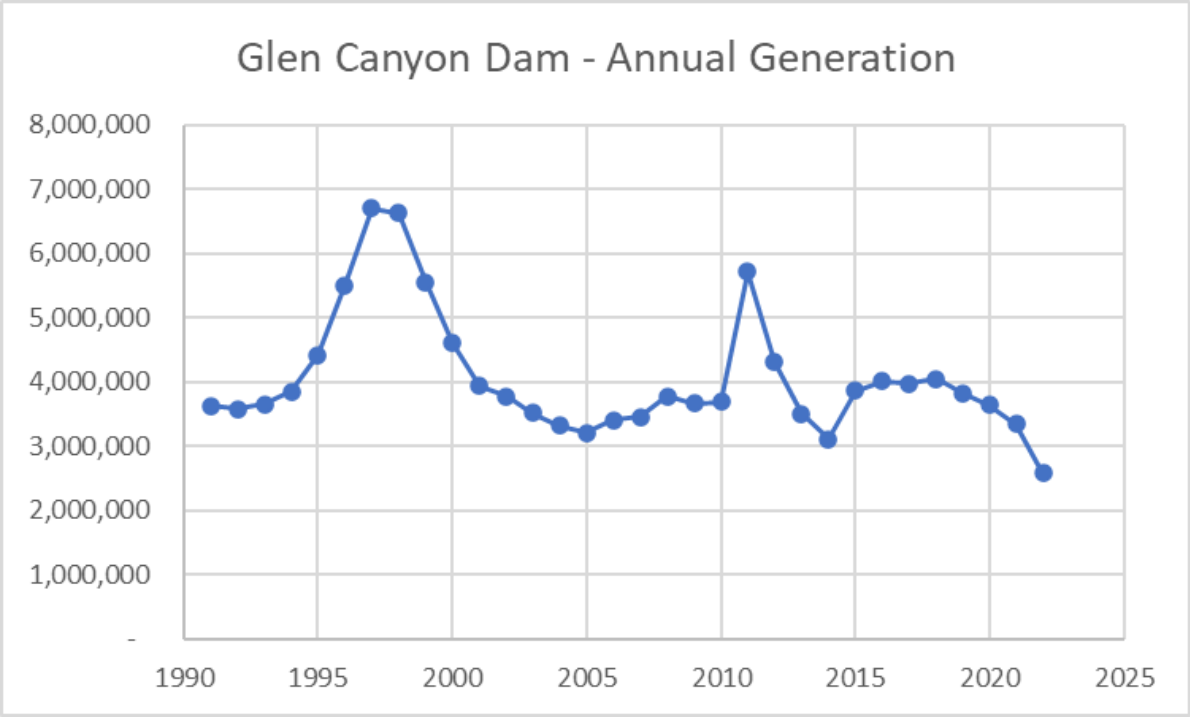
Despite a decrease in head since 2007, sustained annual flows have allowed power generation to continue with an average annual energy production of 3,833 gigawatt hours (GWh) from 2000 through 2020. However, a decrease in flows from 2020 through 2021 resulted in a decline in energy generation (Reclamation 2021d). **Figure 3-47** shows the historical annual generation at Glen Canyon Powerplant from 1991 to 2022.

Figure 3-46
Glen Canyon Powerplant Estimated Power Capacity



Source: Reclamation 2021d

Figure 3-47
Glen Canyon Dam – Annual Generation (MWh)



Source: Reclamation 2023h

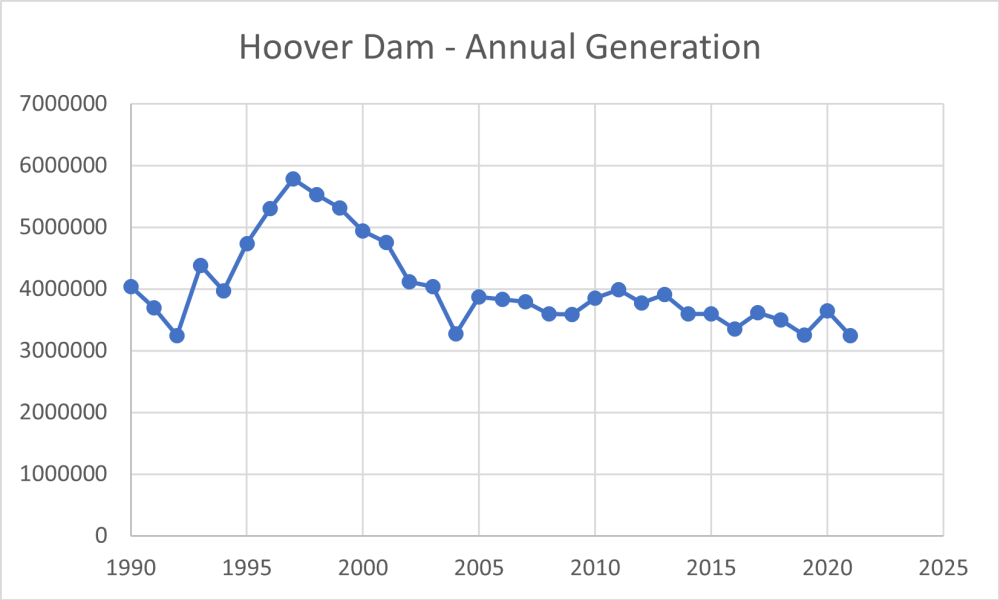
Lake Mead and Hoover Dam

The Hoover Powerplant remains the largest hydropower-generation facility in the Colorado River Basin. Since the 2007 Interim Guidelines, Reclamation has replaced five existing turbines at the powerplant with "wide-head" turbines that run more efficiently at all reservoir elevations at and above the minimum power pool (8NewsNow 2022). These turbines allow Hoover Dam to produce power at elevations 950 feet and greater. In addition to the upgraded turbines, the Hoover Powerplant's staff has upgraded wicket gates (which can open and close to allow or stop water from entering the turbines) at most units, allowing more water to pass through the turbines. Reclamation has also modernized all unit controls, which has also increased efficiency. The facilities also have undergone typical operations and maintenance (Reclamation 2021d).

Similar to conditions at Glen Canyon, the Hoover Powerplant has experienced significant impacts since 2007 due to drought conditions. **Figure 3-48** shows the historical annual generation at Hoover Powerplant from 1991 to 2022. A decrease in lake elevation has led to a decrease in head, resulting in a lower plant capacity. **Figure 3-49** shows the relationship between lake elevation and plant capacity at the Hoover Powerplant. This reduction in head has led to a steady decline in energy production starting in 2015 (Reclamation 2021d).

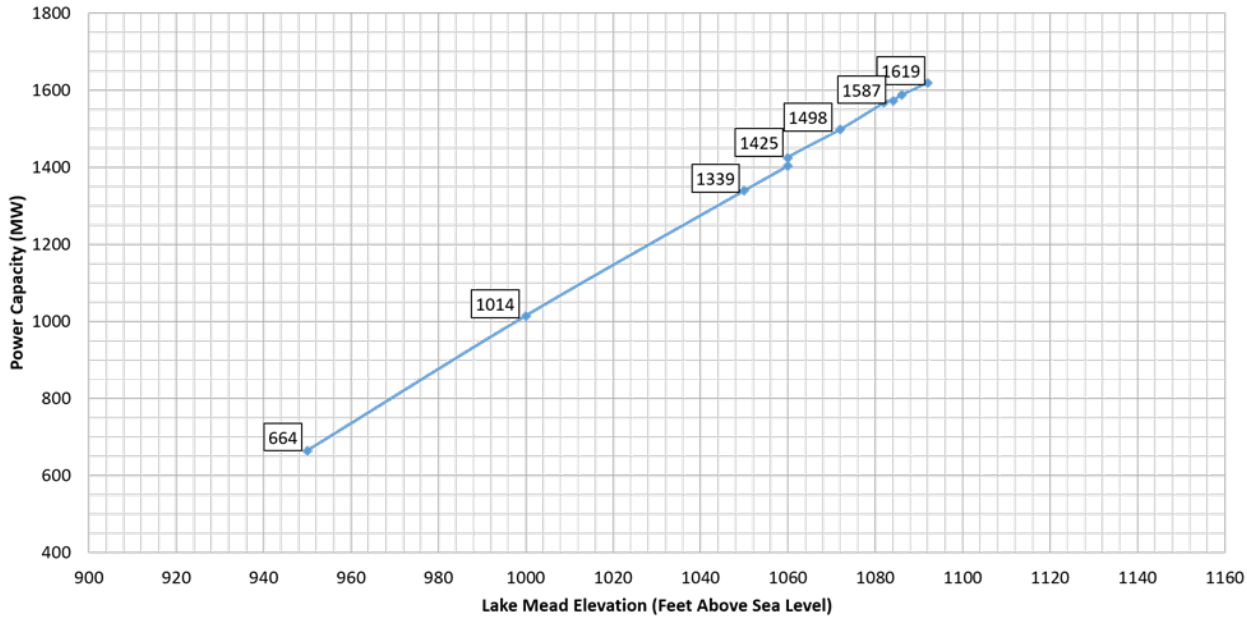
A new contract for hydropower was signed in 2018. Under the new contract, the Hoover Powerplant provides power to 46 customers across Arizona, California, and Nevada. All contracts are nonfirm, which could impact contractors if droughts result in a further reduction in electric power generation (Reclamation 2007, 2021c).

Figure 3-48
Hoover Dam – Annual Generation (MWh)



Source: Reclamation 2021d

Figure 3-49
Low Lake Power Capacity Expectations for Hoover Powerhouse



Source: Reclamation 2021d

Parker-Davis Project

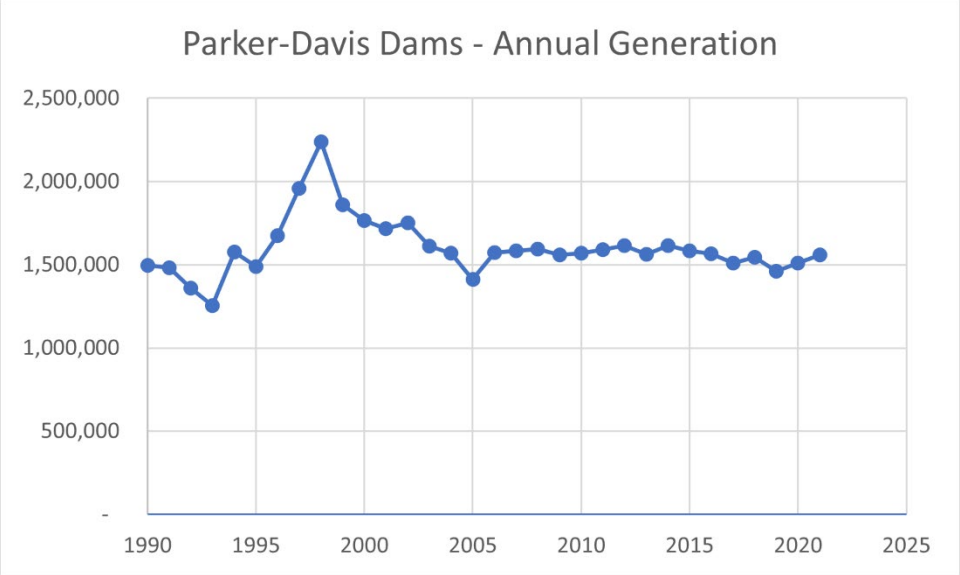
The Parker-Davis Project consists of the Davis Powerplant with five generators and the Parker Powerplant with four generators (Reclamation 2023h). Since 2007, the Parker-Davis Project facilities

have not undergone many significant upgrades. The Parker Powerplant's staff replaced all four turbines between 2004 and 2010. Both powerplants have undergone typical operations and maintenance work since 2007, which has helped with efficiency (Reclamation 2021d).

The drought has had less of an impact on the Parker and Davis Powerplants compared with the Hoover and Glen Canyon Powerplants. This is mostly because the elevations of the lake reservoirs (Lake Havasu above Parker Dam and Lake Mohave above Davis Dam) remain relatively constant. Both dams are run of the river, with some flexibility to control releases (Reclamation 2021d). **Figure 3-50** shows the historical combined annual generation at the Parker and Davis Powerplants.

Due to the relatively constant reservoir elevations, the Parker and Davis Powerplants have had little impact on their capacities. The main impact from drought has been a slight reduction in flows. This reduction in flows has caused a reduction in electric power generation, which has affected the 37 power customers who have contracts with the Parker-Davis Project.

Figure 3-50
Parker-Davis Dam – Annual Generation (MWh)



Source: Reclamation 2023h

Other Small Hydropower Facilities

Several smaller hydropower facilities are below Parker Dam, including Headgate Rock Dam, Senator Wash, Siphon Drop, and Pilot Knob. Headgate Rock Dam is a run-of-the-river powerplant owned and operated by the BIA. Headgate Rock Dam has an elevation protection, resulting in continued generation during the drought. These facilities have been affected only slightly by drought since 2007. Due to the elevation protection and run-of the-river operations, both alternatives would not have a substantial impact on Headgate Rock Powerplant. The other small facilities would not be affected by any of the alternatives and are, therefore, not analyzed further. There are no hydropower facilities adjacent to the Salton Sea; therefore, no impacts on the Salton Sea are analyzed in this section.

Federal Accounts

Upper Colorado River Basin Fund

The CRSP Act of 1956 (43 USC 620d) established the Upper Colorado River Basin Fund (Basin Fund), which collects revenues from the operation of the CRSP facilities and remains available until expended to carry out the project's purposes and operations. The Basin Fund's financial resources are used to repay costs of original investments and to fund operation and maintenance of CRSP units and the CRSP transmission system. The Basin Fund is the sole source of funds for WAPA and Reclamation's operations and maintenance of CRSP facilities. Money in the Basin Fund can be used to fund various governmental programs (GCDAMP 2020). Maintaining a sufficient Basin Fund balance is critical to operating and maintaining reliable CRSP facilities in delivering water to water users and generating and transmitting power to power customers. Additional contributions and uses of the Basin Fund can be found in Section 3.11.6.1 of the 2007 FEIS (Reclamation 2007); this information is incorporated by reference.

Since the 2007 Interim Guidelines, there have been no changes to the manner in which the Basin Fund operates. However, in recent years, the Basin Fund has not been used to fund Colorado River environmental programs. WAPA remains responsible for the transmission and marketing of CRSP power, which impacts the finances of the Basin Fund. However, the Basin Fund has been heavily affected by drought conditions. The reduction of power generation has reduced available resources in the Basin Fund (Reclamation 2021d).

Lower Colorado River Federal Accounts

The Lower Colorado River Basin Funds consist of three separate funds: the Lower Colorado River Basin Development Fund (Development Fund), the Colorado River Dam Fund (Dam Fund), and the Parker-Davis Account. The Dam Fund and the Parker-Davis Account primarily fund all Operations, Maintenance and Capital Improvements for Hoover Dam (Dam Fund) and Parker and Davis Dams (Parker-Davis Account). The Development Fund is partially funded from surcharges on the hydropower produced and charged to Boulder Canyon Project (Hoover Dam) and Parker-Davis Project customers. The Development Fund helps repay the CAP and and helps fund the Salinity Control Project (Reclamation 2021d, 2022d). The Lower Colorado River Multi-Species Conservation Program is funded directly by the Hoover Dam Power Contractors through direct billing by Reclamation and has its own fund. The amount billed by Reclamation for the Lower Colorado River Multi-Species Conservation Program is determined in accordance with the applicable State funding agreement. Additional information on how the funds operate can be found in Section 3.11.6.2 of the 2007 FEIS (Reclamation 2007) and is incorporated by reference.

All three funds have been affected by drought conditions since 2007, but the decrease in financial resources has been manageable. These reductions in financial resources have affected money delivered to the CAP, and the Salinity Control Project (Reclamation 2021d).

Table 3-47 and **Table 3-48** show the amount of money spent on governmental programs from 2015 to 2020 for Hoover Powerplant and the Parker and Davis Powerplants, respectively.

Table 3-47
Historical Revenue Collections at Hoover Powerplant

Fiscal Year	2015	2016	2017	2018	2019	2020
Lower Colorado River Multi-Species Conservation Program ($1,000 per year)	0.0	0.0	0.0	2,227	2,447	2,547
Development Fund – Arizona ($1,000)	3,543	3,131	2,245	2,865	3,444	2,975
Salinity Control Project – California and Nevada ($1,000)	6,568	7,260	7,328	6,590	6,747	6,583

Source: Reclamation 2021d

Table 3-48
Historical Revenue Collections at Parker-Davis Powerplants

Fiscal Year	2015	2016	2017	2018	2019	2020
Development Fund – Arizona Fund ($1,000)	2,715	2,595	2,844	2,732	2,708	2,895
Salinity Control Project – California and Nevada ($1,000)	1,560	1,576	1,451	1,512	1,632	1,475

Source: Reclamation 2021d

Water Supply Systems

The 2007 Interim Guidelines outline three water supply systems that operate from Lake Powell to Lake Mead: the Navajo Generating Station, the City of Page Water Supply Intake, and the Southern Nevada Water Authority Lake Mead Intake. Since the 2007 Interim Guidelines, the Navajo Generating Station has been decommissioned and is no longer withdrawing water from Lake Powell. The City of Page Water Supply Intake at Lake Powell was recently connected to the river outlets, allowing for continued withdrawals down to a lake elevation of 3,370 feet. It withdraws approximately 2,650 af per year, and the City of Page pays the energy costs associated with pumping the water, including operations and maintenance of the pump station. The Southern Nevada Water Authority Intake at Lake Mead was upgraded to allow for water withdrawals down to a reservoir elevation of 825 feet. There have been no changes in operations since 2007.

Surcharges and Ancillary Services

The 2007 Interim Guidelines provide details on surcharges and ancillary services such as regulation and reserve. Reserves are used to quickly replace lost generation from an outage and in times of high energy demands. Drought conditions could potentially drop releases so low that regulation and reserve are no longer possible. Information on conservation before shortage surcharges, ancillary services, regulation, and reserves can be found in Section 4.11.2.6 of the 2007 FEIS (Reclamation 2007), and Sections 3.13.1.3 and 3.13.1.5 of the LTEMP FEIS (Reclamation and NPS 2016).

3.15.2 Environmental Consequences

This section analyzes the potential effects of the Proposed Action on electrical power (or hydropower) resources. The following issues are addressed:

- Impacts on power generation from changes in lake reservoir elevations and releases
- Impacts on the economic value from changes in power generation
- Effects on Upper and Lower Colorado Basin Funds
- Impacts on government programs

Methodology

Reclamation, with the assistance of WAPA, conducted a study of the potential effects of the No Action Alternative and the Proposed Action on electrical power resources of the Colorado River system that included all major facilities. Reclamation's CRMMS modeling results helped develop potential releases, reservoir elevations, power generation, and economic impacts from the alternatives. WAPA's GTMax modeling was used to further analyze impacts on the Glen Canyon Powerplant. The results of these analyses are used throughout this section. All tables in this section were produced using results from either the CRMMS or GTMax modeling results.

Impact Analysis Area

The analysis area includes every major hydropower facility along the Colorado River, from Lake Powell to the SIB. Facilities include the Glen Canyon Powerplant, Hoover Powerplant, Davis Powerplant, and Parker Powerplant. The impact analysis for Parker and Davis Powerplants has been combined because these facilities operate very similarly. Other smaller facilities along the river include Headgate Rock Powerplant, Senator Wash, Siphon Drop, and Pilot Knob. These smaller facilities would not be substantially affected by the alternatives and have, therefore, been removed from further analysis.

Assumptions

There were several assumptions made during the modeling process. The assumptions from the CRMMS modeling of the Upper and Lower Basin are covered in **Section 3.3**, Methodology, with additional information in **Section 3.6**, Hydrologic Resources, and **Appendix D**, CRMMS Model Documentation. Following the CRMMS modeling of the Upper Basin, the GTMax modeling was used for releases from Glen Canyon Dam. Results from the GTMax modeling are only calculated for 1 week each month and then replicated for every week of the month. The CRMMS and GTMax models included estimates of the economic value of electrical energy for each dam. Economic impacts on the various basin funds and federal programs can be difficult to accurately model. A qualitative analysis of the impacts is based on the economic value of electrical energy model results.

Impact Indicators

Electrical power resources are typically evaluated based on hydrologic and economic conditions. The following indicators were used for the analysis:

- Reservoir elevation changes determine the amount of head available, which controls both energy and capacity. Monthly reservoir elevation data were used at Lake Powell, Lake Mead, Lake Havasu, and Lake Mohave.

- Penstock water releases are what power the powerplant turbines and lead to power generation. The CRMMS model estimates monthly releases in the Upper and Lower Colorado Basin. The GTMax model estimates hourly releases at Glen Canyon Dam.
- The economic value of electrical energy is an estimation of economic value at each dam. The value is calculated using modeled generation, capacity, rates, and other economic indicators. These values help analyze impacts on operations, basin funds, and customers.

Issue 1: How would lake reservoir elevations and releases impact power generation?

The electrical power-generation analysis is derived from the GTMax model for the Upper Basin and the CRMMS model for the Lower Basin. These models simulate releases and lake reservoir elevations to calculate an estimated generation. Using the modeled annual elevations and releases, the median, 10th, and 90th percentile annual energy-generation statistics were calculated from operating years 2024–2026 for Glen Canyon, Hoover, Parker, and Davis Powerplants using combined data from 80 percent ESP, 90 percent ESP, and 100 percent ESP. These calculations provide an estimated amount of annual generation under dry hydrologic conditions (minimum and 10th percentile), typical conditions (median), and wet hydrologic conditions (90th percentile and maximum).

Please refer to **Section 3.6.2**, Hydrologic Resources, Environmental Consequences, for more information on when the No Action Alternative and the Proposed Action could potentially result in lake reservoir elevations dropping below minimum power pool.

Summary

Compared with the No Action Alternative, the Proposed Action results in varying degrees of impacts on Glen Canyon Powerplant. In 2024, the Proposed Action would outperform the No Action Alternative under all but the wettest hydrologic conditions. The differences in 2024 would be minimal when compared to the total hydropower generation at Glen Canyon Powerplant. The Proposed Action would continue to outperform the No Action Alternative under the driest conditions, particularly in 2026 when the No Action Alternative has the potential for dropping below minimum power pool and the Proposed Action would greatly outperform the No Action Alternative. However, in 2026 under dry conditions when the No Action Alternative does not drop below power pool, the No Action Alternative would outperform the Proposed Action due to the higher releases from Lake Powell. Under the wettest hydrologic conditions, the No Action Alternative outperforms the Proposed Action in all 3 operating years. This difference is due to the higher releases from Glen Canyon Powerplant under the No Action Alternative. The difference is more varied around the typical hydrologic scenarios due to the possibility of the dams releasing under different Operational Tiers. The differences are not substantially different until 2026, under the driest and wettest hydrologic scenarios. The difference was calculated by subtracting the estimated annual generation of the action alternative from the estimated annual generation of the No Action Alternative. This was repeated for every year and every statistical scenario. **Table 3-49** shows the difference in Glen Canyon Powerplant generation under each action alternative compared with the No Action Alternative.

Table 3-49
Difference in Glen Canyon Powerplant Annual Energy Generation (MWh) Compared with the No Action Alternative

Year	Minimum	10th Percentile	Median	90th Percentile	Maximum
2024	6,336	5,833	5,325	13,201	-25,181
2025	75,244	6,326	-132,360	-12,522	-93,521
2026	754,572	-181,065	-98,764	15,476	-280,072
Total	**836,153**	**-168,905**	**-225,799**	**16,156**	**-398,774**

Source: WAPA 2023

Reduced annual releases at the Hoover Powerplant under the Proposed Action would result in a decrease in generation across all hydrologic scenarios. The impacts would be greater in 2024 with diminishing impacts through 2025–2026. Under dry and typical hydrologic conditions, the Proposed Action begins to outperform the No Action Alternative in 2026. **Table 3-50** shows the difference in Hoover Powerplant generation under each action alternative compared with the No Action Alternative. The difference was calculated by subtracting the estimated annual generation of the Proposed Action by the estimated annual generation of the No Action Alternative.

Table 3-50
Difference in Hoover Powerplant Annual Energy Generation (MWh) Compared with the No Action Alternative

Year	Minimum	10th Percentile	Median	90th Percentile	Maximum
2024	-230,740	-214,646	-218,260	-207,873	-209,390
2025	-80,220	-56,763	-101,470	-111,232	-132,850
2026	2,880	78,691	23,370	-7,864	-129,220
Total	**-308,080**	**-192,718**	**-296,360**	**-326,969**	**-471,460**

Source: Reclamation 2023i

Reduced annual releases at both Parker and Davis Powerplants under the Proposed Action would result in a combined decrease in generation across all hydrologic scenarios. While elevations would be protected to ensure power generation can continue, the reduced releases would impact generation. **Table 3-51** shows the difference in Parker-Davis Powerplants' combined generation under each action alternative compared with the No Action Alternative. The difference was calculated by subtracting the estimated annual generation of the Proposed Action from the estimated annual generation of the No Action Alternative.

Table 3-51
Difference in Parker-Davis Powerplants Annual Energy Generation (MWh) Compared with the No Action Alternative

Year	Minimum	10th Percentile	Median	90th Percentile	Maximum
2024	-108,269	-108,013	-106,629	-106,486	-100,908
2025	-91,075	-79,551	-83,219	-82,586	-81,160

Year	Minimum	10th Percentile	Median	90th Percentile	Maximum
2026	-48,190	-37,193	-41,150	-47,411	-53,765
Total	**-247,534**	**-224,757**	**-230,998**	**-236,483**	**-235,833**

Source: Reclamation 2023i

Overall, the Proposed Action would result in less generation under all but the driest hydrologic conditions when compared to the No Action Alternative. This is the result of lower release volumes throughout the system. Under the driest hydrologic conditions, the No Action Alternative has the potential to drop below power pool at the Glen Canyon Powerplant in 2026, which would result in the Proposed Action substantially outperforming the No Action Alternative. In every other scenario, lower reservoir releases would result in decreased generation under the Proposed Action. Under most hydrologic conditions, decreases in power generation would occur at the highest rates in 2024 and diminish over the lifetime of the SEIS. **Table 3-52** shows the total difference in energy generation across all four powerplants analyzed.

Table 3-52
Total Difference in Annual Energy Generation (MWh) Compared with the No Action Alternative

Year	Minimum	10th Percentile	Median	90th Percentile	Maximum
2024	-332,673	-316,826	-319,564	-301,158	-335,479
2025	-96,051	-129,988	-317,049	-206,340	-307,531
2026	709,262	-139,567	-116,544	-39,799	-463,057
Total	**280,539**	**-586,380**	**-753,157**	**-547,296**	**-1,106,067**

Source: Reclamation 2023i; WAPA 2023

No Action Alternative

Under the No Action Alternative, annual releases from Lake Powell and Lake Mead would continue as outlined in the 2007 Interim Guidelines. At these rates, under the driest hydrologic conditions, there is a potential for water elevations to drop below the minimum power pool at Lake Powell. There were no modeled outcomes that resulted in reservoir elevations at Lake Mead dropping below minimum power pool. Elevation protections at Parker and Davis Dams would allow generation to continue; however, it would drop significantly as releases decrease.

The following tables show the values for annual energy generation at the four analyzed powerplants for the operating years 2024–2026. These values represent the minimum, maximum, median, 10th percentile, and 90th percentile of the modeled annual generation values. These values represent dry hydrologic scenarios (minimum and 10th percentile), typical conditions (median), and wet hydrologic scenarios (90th percentile and maximum). These tables help show the trend of generation over the 3 years analyzed.

Table 3-53 shows the annual generation at Glen Canyon Powerplant under the No Action Alternative. Under the driest hydrologic conditions, reservoir elevations drop below minimum power pool at certain times during 2026, resulting in a complete halt in generation during these times. Under more typical hydrologic conditions, generation would continue at a rate that is

Table 3-53
No Action Alternative – Glen Canyon Annual Energy Generation (MWh)

Year	Minimum	10th Percentile	Median	90th Percentile	Maximum
2024	2,892,718	2,981,905	3,089,765	3,250,747	3,799,233
2025	2,252,933	2,862,174	3,742,452	4,155,556	5,707,082
2026	454,455	2,781,503	3,785,988	4,347,656	7,331,062

Source: WAPA 2023

relatively stable but still well below historical rates, as shown in **Figure 3-47**. Under wetter hydrologic conditions, generation at Glen Canyon Dam would increase over the 3 operating years due to the potential for higher releases.

Table 3-54 shows annual generation at Hoover Powerplant under the No Action Alternative. Under the drier hydrologic conditions, generation decreases over time with the reduction in reservoir elevation and releases. Generation remains relatively stable under typical and wet conditions for the 3 operating years. There is no likelihood of generation going to zero under any conditions.

Table 3-54
No Action Alternative – Hoover Dam Annual Energy Generation (MWh)

Year	Minimum	10th Percentile	Median	90th Percentile	Maximum
2024	2,729,760	2,996,873	3,152,860	3,286,199	3,522,870
2025	2,583,500	2,812,435	3,083,350	3,337,283	3,590,920
2026	2,361,180	2,647,398	3,082,195	3,428,333	3,908,150

Source: Reclamation 2023i

Table 3-55 shows annual combined generation for the Parker and Davis Powerplants under the No Action Alternative. Due to the elevation protections at both dams, generation is able to continue at a relatively constant rate across most hydrologic conditions. There would be minor changes in generation across the hydrologic scenarios but negligible changes throughout the 3 operating years. These trends mirror those found at the Hoover Dam.

Table 3-55
No Action Alternative – Parker-Davis Annual Energy Generation (MWh)

Year	Minimum	10th Percentile	Median	90th Percentile	Maximum
2024	1,308,158	1,409,140	1,476,437	1,541,944	1,661,481
2025	1,313,909	1,394,663	1,475,690	1,547,319	1,669,437
2026	1,285,039	1,377,969	1,463,771	1,549,229	1,679,770

Source: Reclamation 2023i

Table 3-56 shows the combined total annual generation across all four powerplants under the No Action Alternative. The trend under the drier hydrologic conditions typically decreases in generation over the 3-year operating period. Under the typical and wet hydrologic conditions, the trend increase each year.

Table 3-56
No Action Alternative – Total Annual Energy Generation (MWh)

Year	Minimum	10th Percentile	Median	90th Percentile	Maximum
2024	6,930,636	7,387,918	7,719,062	8,078,890	8,983,584
2025	6,150,342	7,069,272	8,301,492	9,040,158	10,967,439
2026	4,100,674	6,806,870	8,331,954	9,325,218	12,918,982

Source: Reclamation 2023i; WAPA 2023

Proposed Action

Under the Proposed Action, additional SEIS conservation would occur below the Glen Canyon Dam. There would also be protections at Lake Powell to avoid dropping below minimum power pool. This Action would have a varying impact on Glen Canyon Powerplant under different hydrologic conditions. The more substantial impacts would be seen at the Hoover and Parker-Davis Powerplants due to the additional SEIS conservation.

The following tables show the values for annual energy generation at the four analyzed powerplants for operating years 2024–2026. These values represent the minimum, maximum, median, 10th percentile, and 90th percentile of the modeled annual generation values. These values represent dry hydrologic scenarios (minimum and 10th percentile), typical conditions (median), and wet hydrologic scenarios (90th percentile and maximum). These tables help show the trend of generation over the 3 years analyzed.

Table 3-57 shows the values for annual energy generation at the Glen Canyon Powerplant for operating years 2024–2026 under the Proposed Action. Under the drier hydrologic conditions, generation would decrease annually over the course of the operating period with a substantial decrease in 2026 under the driest conditions due to the declining releases associated with the elevation protections. However, the protections at Lake Powell would protect minimum power pool and allow for continued generation even at a lower rate. Under typical and wet conditions, trends mirror the No Action Alternative with increases each year.

Table 3-57
Proposed Action – Glen Canyon Annual Energy Generation (MWh)

Year	Minimum	10th Percentile	Median	90th Percentile	Maximum
2024	2,899,055	2,987,738	3,095,090	3,263,948	3,774,052
2025	2,328,177	2,868,501	3,610,092	4,143,034	5,613,562
2026	1,209,028	2,600,438	3,687,223	4,363,132	7,050,990

Source: WAPA 2023

Table 3-58 shows the annual generation at Hoover Powerplant under the Proposed Action. Generation would be lowest under dry conditions and higher under wet conditions, similar to the No Action Alternative. Generation under dry hydrologic conditions would be slightly variable year to year. Under typical and wet conditions, generation would increase each operating year. There would be no likelihood of generation going to zero under any conditions.

Table 3-58
Proposed Action – Hoover Powerplant Annual Energy Generation (MWh)

Year	Minimum	10th Percentile	Median	90th Percentile	Maximum
2024	2,499,020	2,782,227	2,934,600	3,078,326	3,313,480
2025	2,503,280	2,755,672	2,981,880	3,226,051	3,458,070
2026	2,364,060	2,726,089	3,105,565	3,420,469	3,778,930

Source: Reclamation 2023i

Table 3-59 shows the annual combined generation at Parker and Davis Powerplants under the Proposed Action. Generation would lowest under dry conditions and higher under wet conditions, similar to the No Action Alternative. Under any hydrologic condition, generation would slowly increase each operating year.

Table 3-59
Proposed Action – Parker-Davis Annual Energy Generation (MWh)

Year	Minimum	10th Percentile	Median	90th Percentile	Maximum
2024	1,199,889	1,301,127	1,369,808	1,435,458	1,560,573
2025	1,222,834	1,315,112	1,392,471	1,464,733	1,588,277
2026	1,236,849	1,340,776	1,422,621	1,501,818	1,626,005

Source: Reclamation 2023i

Table 3-60 shows the total combined annual generation across all four powerplants under the Proposed Action. The drier scenarios show annual decreases, with a substantial impact under the driest conditions in 2026 due to the likelihood of dropping below minimum power pool at Lake Powell. Generation would increase annually under typical and wet conditions.

Table 3-60
Proposed Action – Total Annual Energy Generation (MWh)

Year	Minimum	10th Percentile	Median	90th Percentile	Maximum
2024	6,597,964	7,071,092	7,399,498	7,777,732	8,648,105
2025	6,054,291	6,939,285	7,984,443	8,833,818	10,659,909
2026	4,809,937	6,667,303	8,215,409	9,285,419	12,455,925

Source: Reclamation 2023i; WAPA 2023

Cumulative Effects

The potential operational changes included in the LTEMP SEIS flow options could result in an impact in power generation at the Glen Canyon Powerplant. If implemented, some of the flow options could alter how water is released through Glen Canyon Dam by releasing water through the river outlets as opposed to the power-generating penstocks. This could result in a cumulative negative impact on power generation across most alternatives outlined in this SEIS. The changes in sediment accounting windows could have impacts on hydropower generation at the Glen Canyon Powerplant. HFEs at different times of year could result in some impacts on generation. Specific effects related to these resource tradeoffs are being addressed in greater detail in the LTEMP SEIS because they are more closely related to subannual flow considerations described there versus the

annual considerations described here. Annual volume releases from Lake Powell would not change under the LTEMP SEIS; therefore, no additional impacts would occur at any downstream powerplants.

No cumulative effects would occur on power generation due to the proposed management activities planned in the Salton Sea 10-Year Plan or the environmental assessment for the implementation of the 10-Year Plan's projects. No cumulative impacts would result as the Proposed Action is not adding additional impacts to those that are already occurring; however, these impacts might occur sooner under the Proposed Action.

Issue 2: How would changes in lake reservoir elevations impact capacity?

The capacity analysis is derived from the GTMax model for the Upper Basin and the CRMMS model for the Lower Basin. These models simulate lake reservoir elevations and generator availability to calculate an estimated capacity. Using the modeled annual elevations and unit availability, the median, 10th, and 90th percentile monthly capacity statistics were calculated for operating years 2024–2026 for Glen Canyon, Hoover, Parker, and Davis Powerplants using combined data from 80 percent ESP, 90 percent ESP, and 100 percent ESP. These calculations provide an estimated amount of annual capacity under dry hydrologic conditions (minimum and 10th percentile), typical conditions (median), and wet hydrologic conditions (90th percentile and maximum). WAPA and Reclamation used the estimated capacity for the month of August as a yearly representation due to the peak energy demands and available capacity during that month.

The capacity at the Parker and Davis Powerplants does not fluctuate greatly due to the lake reservoir elevation protections. It is expected that these capacities will remain relatively constant across all alternatives. Therefore, the Parker and Davis Powerplants are not included in the capacity analysis.

Summary

Compared with the No Action Alternative, the Proposed Action would result in minor variations in capacity at Glen Canyon Powerplant under all but the most extreme hydrologic scenarios. The differences are primarily due to the differences in lake elevation and releases. Overall, the differences are relatively minor across most years and under most hydrologic conditions. The No Action Alternative outperforms the Proposed Action in 2025 under the driest and wettest hydrologic scenarios by 154 and 125 MW respectively. The Proposed Action would outperform the No Action Alternative in 2026 by 207 MW, due to the potential for the No Action Alternative to drop below minimum power pool. The difference was calculated by subtracting the estimated August capacity of the action alternative from the estimated August capacity of the No Action Alternative. This was repeated for every year and every statistical scenario. **Table 3-61** shows the difference in Glen Canyon Powerplant capacity under each action alternative compared with the No Action Alternative.

Table 3-61
Difference in Glen Canyon Powerplant August Capacity (MW) Compared with the No Action Alternative

Year	Minimum	10th Percentile	Median	90th Percentile	Maximum
August 2024	2	1	2	8	6
August 2025	-154	-1	3	-8	-125
August 2026	207	-21	1	22	19

Source: WAPA 2023

Lake reservoir elevations at Lake Mead are variable across the different hydrologic conditions, resulting in variable capacity differences between alternatives. Under all hydrologic conditions the Proposed Action would outperform the No Action Alternative across all 3 operating years. The amount of difference is variable, with the Proposed Action outperforming the No Action Alternative in 2025–2026 under dry hydrologic conditions. **Table 3-62** shows the difference in Hoover Powerplant capacity under the Proposed Action compared with the No Action Alternative. The difference was calculated by subtracting the estimated August capacity of the Proposed Action from the estimated August capacity of the No Action Alternative.

Table 3-62
Difference in Hoover Powerplant August Capacity (MW) Compared with the No Action Alternative

Year	Minimum	10th Percentile	Median	90th Percentile	Maximum
August 2024	45	47	45	39	62
August 2025	90	89	79	36	27
August 2026	66	115	92	49	16

Source: Reclamation 2023i

No Action Alternative

Under the No Action Alternative, annual operations at Lake Powell and Lake Mead would continue as outlined in the 2007 Interim Guidelines. At these operations, under the driest hydrologic conditions, there is potential for Lake Powell's reservoir elevations to drop below minimum power pool, which would result in a complete loss of capacity.

The following tables show the values for August capacity at Glen Canyon and Hoover Powerplants for operating years 2024–2026. These values represent the minimum, maximum, median, 10th percentile, and 90th percentile of the modeled August capacity values. These values represent dry hydrologic scenarios (minimum and 10th percentile), typical conditions (median), and wet hydrologic scenarios (90th percentile and maximum). These tables help show the trend of potential capacity over the 3 years analyzed.

Table 3-63 shows the August capacity at Glen Canyon Powerplant under the No Action Alternative. Under drier hydrologic conditions, lake elevations drop, resulting in less capacity compared with the wetter hydrologic scenarios. Under more typical and wetter hydrologic conditions, capacity would increase over the operating period as Lake Powell would begin to fill and lake reservoir elevations would increase.

Table 3-63
No Action Alternative – Glen Canyon August Capacity

Year	Minimum	10th Percentile	Median	90th Percentile	Maximum
August 2024	430	458	495	550	602
August 2025	364	447	567	655	1,108
August 2026	0	433	569	666	1,116

Source: WAPA 2023

Table 3-64 shows August capacity at Hoover Powerplant under the No Action Alternative. Similar to Glen Canyon, under dry hydrologic conditions, the lake elevation would decline, resulting in diminished capacity, with the potential for elevations to continue to drop over the 3-year period. Under typical or wet hydrologic conditions, capacity would be maintained at a relatively similar rate across the 3 operating years. The wettest hydrologic conditions would result in a large increase in capacity in 2026.

Table 3-64
No Action Alternative – Hoover Dam August Capacity

Year	Minimum	10th Percentile	Median	90th Percentile	Maximum
August 2024	1150	1170	1217	1291	1352
August 2025	1034	1078	1204	1327	1399
August 2026	890	990	1203	1351	1603

Source: Reclamation 2023i

Proposed Action

Under the Proposed Action, actions would be taken to maintain an elevation of 3,500 feet at Lake Powell, allowing for continued capacity at Glen Canyon Powerplant even under the driest hydrologic conditions. This alternative would include protections to avoid dropping below the minimum power pool at Glen Canyon Dam. However, protecting elevations at Lake Powell under the drier conditions could result in a decrease in elevation at Lake Mead in operating year 2026.

The following tables show the values for August capacity at Glen Canyon and Hoover Powerplants for operating years 2024–2026. These values represent the minimum, maximum, median, 10th percentile, and 90th percentile of the modeled August capacity values. These values represent dry hydrologic scenarios (minimum and 10th percentile), typical conditions (median), and wet hydrologic scenarios (90th percentile and maximum). These tables help show the trend of capacity over the 3 years analyzed.

Table 3-65 shows the values for August capacity at the Glen Canyon Powerplant for operating years 2024–2026 under the Proposed Action. Capacity would continue in August across all hydrologic conditions due to the elevation protection at Lake Powell. However, under the drier conditions, capacity would continue to drop over the 3-year operating period due to decline lake elevations. Under typical and wetter conditions, capacity would increase over the operating period as lake elevations rise.

Table 3-65
Proposed Action – Glen Canyon August Capacity

Year	Minimum	10th Percentile	Median	90th Percentile	Maximum
August 2024	432	459	497	558	608
August 2025	210	446	570	647	983
August 2026	207	412	570	688	1,135

Source: WAPA 2023

Table 3-66 shows the August capacity at Hoover Powerplant under the Proposed Action. Under the drier hydrologic conditions, the capacity at Hoover Dam would be low due the low reservoir elevation and would continue to decrease over the 3-year period. The capacity would be higher under each wetter hydrologic condition and would continue to increase over the 3-year period. This would be the result of maintained higher reservoir elevations.

Table 3-66
Proposed Action – Hoover Powerplant August Capacity

Year	Minimum	10th Percentile	Median	90th Percentile	Maximum
August 2024	1195	1217	1261	1329	1415
August 2025	1124	1167	1283	1364	1426
August 2026	957	1105	1295	1400	1619

Source: Reclamation 2023i

Cumulative Effects

The potential operational changes included in the LTEMP SEIS flow options could result in an impact to power capacity at the Glen Canyon Powerplant during the implementation of these flow options. If one of the flow options were to be implemented, water could be released through the river outlets as opposed to the power-generating penstocks. This could result in additional operating constraints during these flow periods. The cumulative negative impact on capacity could occur across most alternatives outlined in this SEIS. These impacts would be temporary—only occurring during the timeframe the flow options were implemented—and would not impact capacity outside of these periods. The changes in sediment account windows could have minimal temporary impacts on capacity at the Glen Canyon Powerplant. Changes in when HFEs occur would change capacity during these events. The amount and magnitude of the HFEs would be within the bounds analyzed in LTEMP. Specific effects related to these resource tradeoffs are being addressed in greater detail in the LTEMP SEIS because they are more closely related to subannual flow considerations described there versus the annual considerations described here. Annual volume releases from Lake Powell would not change; therefore, no additional impacts would occur at any downstream powerplants.

No cumulative effects would occur on hydropower capacity due to the proposed management activities planned in the Salton Sea 10-Year Plan or the environmental assessment for the implementation of the 10-Year Plan's projects. No cumulative impacts would result as the Proposed Action is not adding additional impacts to those that are already occurring; however, these impacts might occur sooner under the Proposed Action.

Issue 3: How would changes in power generation and capacity impact the economic value of electrical energy?

The economic value of electrical energy analysis is also derived from the GTMax model for the Upper Basin and the CRMMS model for the Lower Basin. Given the calculated energy generation and capacity, estimates can be made on the average annual economic value of electrical energy for each powerplant. Economic modeling from Reclamation and WAPA uses an hourly operation schedule that maximizes the economic value of hydropower generation. Hourly pricing data used in WAPA's study are derived from the Palo Verde hub and supplemented by other sources. Using the modeled energy-generation values, the minimum, median, maximum, 10th percentile, and 90th percentile annual economic value of electrical energy statistics were calculated for operating years 2024 to 2026 for the Glen Canyon, Hoover, Parker, and Davis Powerplants using combined data from 80 percent ESP, 90 percent ESP, and 100 percent ESP. These calculations provide an estimated amount of annual hydropower value under dry hydrologic conditions (minimum and 10th percentile), typical conditions (median), and wet hydrologic conditions (90th percentile and maximum).

In addition to the economic modeling, WAPA also conducted an analysis on impacts on rates for the Salt Lake City Area/Integrated Projects (SLCA/IP). This analysis on rates is included at the end of this issue.

Summary

The Proposed Action would result in varied economic value of electrical energy at Glen Canyon Powerplant when compared with the No Action Alternative. The difference would be larger under the driest hydrologic scenarios due to the likelihood of dropping below minimum power pool under the No Action Alternative in 2026. The remaining hydrologic scenarios are more varied but generally see the No Action Alternative slightly outperform the Proposed Action, particularly in operating year 2026. The additional protections at Lake Powell under the Proposed Action would result in slightly lower releases, which would decrease the economic value of electrical energy when compared to the No Action. These differences are relatively small when compared to the long-term economic value of electrical energy. **Table 3-67** shows the difference in the Glen Canyon Powerplant under the Proposed Action when compared with the No Action Alternative.

Reduced generation under the Proposed Action would result in a decrease in total economic value of electrical energy across all hydrologic scenarios at the Hoover Powerplant when compared with the No Action Alternative. The difference would be largest under the wetter hydrologic conditions due to the additional value from higher releases under the No Action Alternative. While these differences are greater than those at Glen Canyon Powerplant, they are still relatively small compared to annual revenue. **Table 3-68** shows the difference in the Hoover Powerplant under the Proposed Action when compared with the No Action Alternative.

Table 3-67
Difference in the Glen Canyon Powerplant's Economic Value of Electrical Energy Compared with the No Action Alternative (Thousands of Dollars)

Year	Minimum	10th Percentile	Median	90th Percentile	Maximum
2024	$509	$461	$403	$1,675	-$2,387
2025	-$11,984	$476	-$4,693	-$375	-$13,459
2026	$64,575	-$12,458	-$4,265	$4,256	-$10,181
Total	**$53,100**	**-$11,521**	**-$8,554**	**$5,557**	**-$26,027**

Source: WAPA 2023

Table 3-68
Difference in the Hoover Powerplant's Economic Value of Electrical Energy Compared with the No Action Alternative (Thousands of Dollars)

Year	Minimum	10th Percentile	Median	90th Percentile	Maximum
2024	-$23,912	-$22,591	-$22,864	-$22,434	-$22,688
2025	-$4,915	-$4,685	-$9,708	-$12,847	-$15,285
2026	$389	$10,821	$3,489	-$4,546	-$17,940
Total	**-$28,438**	**-$16,455**	**-$29,083**	**-$39,827**	**-$55,913**

Source: Reclamation 2023i

The combined reduced generation under the Proposed Action would result in a decrease in the economic value of electrical energy across all hydrologic scenarios at the Parker and Davis Powerplants when compared with the No Action Alternative. The decrease in value would be very consistent between hydrologic conditions. Decreases would begin to diminish over the 3-year period. **Table 3-69** shows the difference in the combined Parker and Davis Powerplants under the Proposed Action when compared with the No Action Alternative.

Table 3-69
Change in the Parker-Davis Powerplants' Economic Value of Electrical Energy Compared with the No Action Alternative (Thousands of Dollars)

Year	Minimum	10th Percentile	Median	90th Percentile	Maximum
2024	-$11,856	-$12,012	-$11,821	-$11,714	-$11,303
2025	-$10,454	-$9,383	-$9,621	-$9,614	-$9,615
2026	-$6,302	-$5,644	-$6,048	-$6,559	-$7,166
Total	**-$28,612**	**-$27,039**	**-$27,490**	**-$27,887**	**-$28,084**

Source: Reclamation 2023i

Table 3-70 combines the total economic value of electrical energy for all four powerplants to analyze overall economic impacts under the Proposed Action when compared with the No Action Alternative. The No Action Alternative outperforms the Proposed Action under all hydrologic conditions. The greatest differences are found in the wettest hydrologic conditions due to the higher releases at both Glen Canyon and Hoover Dams. The only time when the Proposed Action outperforms the No Action Alternative is under the driest conditions during operating year 2026 at Lake Powell when the No Action Alternative has the potential dropping below minimum power pool.

Table 3-70
Total Change in the Economic Value of Electrical Energy Compared with the No Action Alternative (Thousands of Dollars)

Year	Minimum	10th Percentile	Median	90th Percentile	Maximum
2024	-$35,259	-$34,142	-$34,282	-$32,473	-$36,378
2025	-$27,353	-$13,592	-$24,022	-$22,836	-$38,359
2026	$58,662	-$7,281	-$6,824	-$6,849	-$35,287
Total	**-$3,950**	**-$55,015**	**-$65,127**	**-$62,157**	**-$110,024**

Source: Reclamation 2023i; WAPA 2023

No Action Alternative

Under the No Action Alternative, annual releases from Lake Powell and Lake Mead would continue as outlined in the 2007 Interim Guidelines. At these rates, the likelihood of water elevations dropping below the minimum power pool at Lake Powell increases. As lake elevations decline, generation and capacity would decrease and halt as soon as elevations drop below the minimum power pool. Economic value of electrical energy trends typically mirror generation and capacity trends; therefore, when generation and capacity are reduced or stop, the economic value of electrical energy is also reduced or halted. Therefore, the economic value of electrical energy is much lower under low hydrologic scenarios.

The following tables show the annual economic value of electrical energy at the four analyzed powerplants for operating years 2024–2026. These values represent the minimum, maximum, median, 10th percentile, and 90th percentile of the modeled annual generation values. These values represent dry hydrologic scenarios (minimum and 10th percentile), typical conditions (median), and wet hydrologic scenarios (90th percentile and maximum). These tables help show the trend of economic value of electrical energy over the 3 years analyzed.

Table 3-71 shows the annual economic value of electrical energy at the Glen Canyon for operating years 2024–2026 under the No Action Alternative. Under the drier hydrologic conditions, the economic value of electrical energy decreases annually over the operating period. Generation and capacity are near or below minimum power pool under the driest hydrologic conditions in 2026, resulting in a near or complete halt in total hydropower value. At typical and wet hydrologic conditions, the economic value of electrical energy increases annually over the 3-year operating period.

Table 3-71
No Action Alternative – Glen Canyon Dam Annual Economic Value of Electrical Energy (Thousands of Dollars)

Year	Minimum	10th Percentile	Median	90th Percentile	Maximum
2024	$224,591	$233,241	$245,110	$261,680	$300,694
2025	$181,657	$219,699	$285,810	$317,923	$483,331
2026	$42,894	$208,929	$283,265	$325,065	$566,485
Total	**$449,142**	**$661,869**	**$814,185**	**$904,668**	**$1,350,510**

Source: WAPA 2023

Revenue from the Hoover Powerplant customer contracts is set each year. However, impacts from decreases in generation and capacity are still felt. When generation and capacity are reduced or halted, the impacts on electrical energy value are still substantial. The wetter hydrologic scenarios result in consistent economic value of electrical energy through the 3 operating years. In the typical and drier hydrologic scenarios, the economic value of electrical energy is substantially affected by the reduction in generation and capacity. These drier scenarios also see a continued decrease in value over the 3-year operating period. **Table 3-72** shows the annual economic value of electrical energy for Hoover Powerplant under the No Action Alternative.

Revenue from the combined Parker and Davis Powerplants' customer contracts is set each year and impacts from decreases in generation and capacity are much less compared with the Glen Canyon and Hoover Powerplants. The Parker and Davis Powerplants have low but variable revenue over the 3-year period under the driest hydrologic conditions. The revenue increases with each wetter scenario. However, each scenario does show decreases over the 3-year operating period. **Table 3-73** shows the combined annual economic value of electrical energy for Parker and Davis Powerplants under the No Action Alternative.

Table 3-72
No Action Alternative – Hoover Dam Annual Economic Value of Electrical Energy (Thousands of Dollars)

Year	Minimum	10th Percentile	Median	90th Percentile	Maximum
2024	$360,784	$387,085	$404,852	$422,404	$449,904
2025	$333,570	$358,756	$391,697	$424,177	$454,242
2026	$295,801	$329,456	$383,887	$427,496	$489,071
Total	**$990,155**	**$1,075,297**	**$1,180,436**	**$1,274,077**	**$1,393,217**

Source: Reclamation 2023i

Table 3-73
No Action Alternative – Parker-Davis Dams Annual Economic Value of Electrical Energy (Thousands of Dollars)

Year	Minimum	10th Percentile	Median	90th Percentile	Maximum
2024	$124,798	$133,904	$140,161	$146,394	$158,147
2025	$122,542	$129,318	$136,762	$143,419	$155,210
2026	$116,295	$124,298	$132,115	$139,681	$151,975
Total	**$363,635**	**$387,520**	**$409,038**	**$429,494**	**$465,332**

Source: Reclamation 2023i

Table 3-74 shows the combined total economic value of electrical energy across all four powerplants under the No Action Alternative. The trend typically mirrors those from Glen Canyon, as they exhibit the dominant changes across hydrologic scenarios and operating years. The driest hydrologic scenario results in a substantial decrease in hydropower value each year as Lake Powell approaches and drops below minimum power pool.

Table 3-74
No Action Alternative – Total Annual Economic Value of Electrical Power (Thousands of Dollars)

Year	Minimum	10th Percentile	Median	90th Percentile	Maximum
2024	$710,173	$754,230	$790,123	$830,478	$908,745
2025	$637,769	$707,773	$814,269	$885,519	$1,092,783
2026	$454,990	$662,683	$799,267	$892,242	$1,207,531
Total	**$1,802,932**	**$2,124,686**	**$2,403,659**	**$2,608,239**	**$3,209,059**

Source: Reclamation 2023i; WAPA 2023

Proposed Action

Under the Proposed Action, power generation and capacity at the Glen Canyon Powerplant would vary under different hydrologic conditions, resulting in varying impacts on the economic value of electrical energy. The economic value of electrical energy at the Hoover Powerplant would decrease as lake elevations and releases decline at Lake Mead. Revenue from generation at Parker and Davis Powerplants would remain relatively consistent but would also decrease as releases decline.

The following tables show the annual economic value of electrical energy at the four analyzed powerplants for operating years 2024–2026. These values represent the minimum, maximum, median, 10th percentile, and 90th percentile of the modeled annual generation values. These values represent dry hydrologic scenarios (minimum and 10th percentile), typical conditions (median), and wet hydrologic scenarios (90th percentile and maximum). These tables help show the trend of hydropower value over the 3 years analyzed.

Table 3-75 shows the values for the annual economic value of electrical energy at the Glen Canyon Powerplant for operating years 2024–2026 under the Proposed Action. Under the drier hydrologic conditions, the economic value of electrical energy would decline annually as lake elevations and releases continue to drop. The wetter conditions would show annual increases in the economic value of electrical energy. These trends mirror lake elevation and release trends outlined in **Section 3.6**.

Table 3-75
Proposed Action – Glen Canyon Dam Annual Economic Value of Electrical Energy (Thousands of Dollars)

Year	Minimum	10th Percentile	Median	90th Percentile	Maximum
2024	$225,100	$233,702	$245,514	$263,355	$298,307
2025	$169,673	$220,175	$281,117	$317,548	$469,871
2026	$107,469	$196,471	$279,000	$329,321	$556,305
Total	**$502,242**	**$650,348**	**$805,631**	**$910,224**	**$1,324,484**

Source: WAPA 2023

Table 3-76 shows the annual economic value of electrical energy at the Hoover Powerplant under the Proposed Action. The economic value of electrical energy would be lowest under the drier hydrologic conditions and would continue to decrease over the 3-year operating period. The typical hydrologic conditions would show consistent value, with a slight uptick in operating year 2026. The wetter hydrologic scenarios would show higher total hydropower value that increases with each operating year. Alternative sources of revenue, such as visitor fees to Hoover Dam, would continue; however, these are only targeted to be enough to cover the cost of visitor services.

Table 3-76
Proposed Action – Hoover Dam Annual Economic Value of Electrical Energy
(Thousands of Dollars)

Year	Minimum	10th Percentile	Median	90th Percentile	Maximum
2024	$336,872	$364,494	$381,988	$399,970	$427,216
2025	$328,655	$354,071	$381,989	$411,330	$438,957
2026	$296,190	$340,277	$387,376	$422,950	$471,131
Total	**$961,717**	**$1,058,842**	**$1,151,353**	**$1,234,250**	**$1,337,304**

Source: Reclamation 2023i

Table 3-77 shows the combined annual economic value of electrical energy at the Parker and Davis Powerplants. The combined total economic value of electrical energy would increase with wetter hydrologic conditions. Each scenario would show slight decreases in economic value of electrical energy over the course of the 3-year operating period.

Table 3-77
Proposed Action – Parker-Davis Dams Annual Economic Value of Electrical Energy
(Thousands of Dollars)

Year	Minimum	10th Percentile	Median	90th Percentile	Maximum
2024	$112,942	$121,892	$128,340	$134,680	$146,844
2025	$112,088	$119,935	$127,141	$133,805	$145,595
2026	$109,993	$118,654	$126,067	$133,122	$144,809
Total	**$335,023**	**$360,481**	**$381,548**	**$401,607**	**$437,248**

Source: Reclamation 2023i

Table 3-78 shows the total combined annual economic value of electrical energy across all four powerplants under the Proposed Action. Trends typically mirror Glen Canyon Powerplant, as it shows the most variation in impacts from the Proposed Action. The economic value of electrical energy would decrease annually under the drier hydrologic conditions and increase annually under the typical and wet conditions.

Table 3-78
Proposed Action – Total Annual Economic Value of Electrical Energy (Thousands of Dollars)

Year	Minimum	10th Percentile	Median	90th Percentile	Maximum
2024	$674,914	$720,088	$755,842	$798,005	$872,367
2025	$610,416	$694,181	$790,247	$862,683	$1,054,423
2026	$513,652	$655,402	$792,443	$885,393	$1,172,245
Total	**$1,798,982**	**$2,069,671**	**$2,338,532**	**$2,546,081**	**$3,099,036**

Source: Reclamation 2023i; WAPA 2023

Rates

CRSP estimated the impact of the Proposed Action and No Action Alternative on the SLCA/IP firm power rate. WAPA's CRSP office markets SLCA/IP electrical energy and power as a firm electrical product. Mostly this consists of electrical power from the large CRSP dams. The SLCA/IP rate change requires that WAPA engage in an official rule-making process. The estimated rate impact in **Table 3-79** below does not include all the steps and processes that would be included in an official rate proceeding. These numbers are for comparative purposes only.

Table 3-79
SLCA/IP Firm Electric Service Impacts

No Action Alternative	Composite Rate ($/MWh)	Difference between Alternatives	Percent Difference
2024	31.75	-	-
2025	30.68	-	-
2026	29.91	-	-
Average	30.78	-	-
Proposed Action	**Composite Rate ($/MWh)**	**Difference between Alternatives**	**Percent Difference**
2024	31.71	-0.04	-0.13%
2025	30.89	0.21	0.68%
2026	29.98	0.07	0.23%
Average	30.86	0.08	0.26%

Source: WAPA 2023

Expenses constitute the numerator in the calculation of the SLCA/IP rate. This number is divided by the expected number of KWhs WAPA expects to sell in a year. The result (expenses divided by sales) gives the revenue requirement per KWh sold: the SLCA/IP rate. For expenses, WAPA used the current proposed expenses from its 206 rate process for the years 2024–2026. For the expected sales for each year, WAPA used the generation numbers it modeled for the No Action Alternative and the Proposed Action.

Cumulative Effects

The potential operational changes included in the LTEMP SEIS flow options could result in a decrease in power generation and capacity—and, therefore, economic value—of electrical energy at

the Glen Canyon Powerplant if flows typically released through the penstocks are rerouted through the river outlet works. The reduction in generation could be offset by the purchase of replacement power. These operational changes would have no impacts on the economic value of hydropower at Hoover, Parker, or Davis Powerplants.

Changes in when HFEs occur would change the economic value of electrical energy during these events. The amount and magnitude of the HFEs would be within the bounds analyzed in LTEMP. Annual volume releases from Lake Powell would not change; therefore, no additional impacts would occur at any downstream powerplants.

Specific effects related to these resource tradeoffs are being addressed in greater detail in the LTEMP SEIS because they are more closely related to subannual flow considerations described there versus the annual considerations described here. These specific effects will include grid impact using the PLEXOS model. Please see the LTEMP SEIS for more information.

No cumulative effects on power generation, capacity, or (therefore) economic value of electrical energy would occur due to the proposed management activities planned in the Salton Sea 10-Year Plan or the environmental assessment for the implementation of the 10-Year Plan's projects. No cumulative impacts would result as the Proposed Action is not adding additional impacts to those that are already occurring; however, these impacts might occur sooner under the Proposed Action.

Issue 4: How would changes in economic value of electrical energy impact the various federal accounts?

The various federal accounts are operated in different manners and, therefore, are affected differently based on the alternative and the associated revenue. The Basin Fund receives revenue from customers based on contracts and operations at the Glen Canyon Powerplant. The Development Fund receives revenue from customers based on contracts and operations at the Hoover, Parker, and Davis Powerplants. The Dam Fund and Parker-Davis Account receive a set revenue directly from customers based on contracts. Implementation of the various alternatives would likely result in more variation in the federal accounts and could lead to additional actions, such as power rate adjustments, rate surcharges, or reductions to customer allocations, to respond to shortfalls in revenue under dry conditions.

The following qualitative analysis is based on revenue and economic value of electrical energy modeling associated with each analyzed powerplant under each action alternative. Quantitative impacts are difficult to accurately model.

Summary

Lake Powell has the potential to drop below minimum power pool under the No Action Alternative. Loss of generation would result in multiple severe impacts, including the loss of revenues necessary for the Basin Fund to support critical operations at WAPA and Reclamation. Additional analysis on the impacts from economical changes in electrical energy can be found in **Section 3.16** and **Section 3.17**. Compared with the No Action Alternative, the Proposed Action would result in increased economic value of electrical energy at the Glen Canyon Powerplant under the driest conditions in 2026 and, therefore, would ensure that there would be sufficient resources available in the Basin

Fund to support operations and maintenance. The Proposed Action has varying impacts on the economic value of electrical energy under the other hydrologic conditions but would typically negatively impact economic value of electrical energy and therefore the Basin Fund. These impacts would be greatest in 2024 and diminish over the operating period as described in Issue 3.

Compared with the No Action Alternative, the Proposed Action would decrease the economic value of electrical energy at Hoover Dam, resulting in a decrease in financial resources for the Development Fund. Under the Proposed Action, the Parker and Davis Powerplants would also see a decrease in economic value of electrical energy and would continue to impact the Development Fund. The No Action Alternative would allow for greater hydropower value at the Hoover, Parker, and Davis Powerplants and would result in the least number of impacts on the Development Fund.

The Dam Fund and Parker-Davis Account would receive the same amount of revenue from customers under both alternatives and would only be affected by operations and maintenance costs. It can be assumed that the impacts under the Proposed Action would be greater than the impacts under the No Action Alternative due to the decreased releases and economic value of electrical energy.

No Action Alternative

Under the No Action Alternative, the economic value of electrical energy and Basin Fund would decrease annually at the Glen Canyon Powerplant under the drier hydrologic conditions. Elevations of Lake Powell have the potential to drop below the minimum power pool, halting generation and drastically reducing the economic value of electrical energy. Any large reduction or halt in the economic value of electrical energy would have severe impacts on the Basin Fund. Under wetter hydrologic conditions, electrical energy increases annually and would therefore increase the Basin Fund.

The Development Fund would remain relatively unaffected under wet hydrologic scenarios under the No Action Alternative. However, during the driest hydrologic scenarios, economic value of electrical energy could be affected, particularly later in the project timeline, and could result in impacts on the Development Fund.

The Dam Fund and Parker-Davis Account receive a set amount of revenue directly from customers and would only see minor impacts from the No Action Alternative. Reduced generation and capacity at the Hoover Powerplant would have slight impacts on the Dam Fund. The lake reservoir elevation protections at Lake Havasu and Lake Mohave allow for continued generation, capacity, and hydropower value at the Parker and Davis Powerplants. There would be a slight decrease in releases, which would impact the generation and economic value of electrical energy; this would result in minor impacts on the Parker-Davis Account.

Proposed Action

Under the Proposed Action, the economic value of electrical energy would decrease over the operating period under the drier hydrologic conditions. This would result in a decline in the Basin Fund. Maintaining the elevation of Lake Powell at 3,500 feet would allow for the economic value of electrical energy to continue. During wetter hydrologic conditions, the economic value of electrical energy would increase over the operating period, resulting in increases to the Basin Fund.

Under the Proposed Action, Lake Mead reservoir elevations and releases could drop under the dry hydrologic conditions and negatively impact the Development Fund. These impacts would be greater as the operating period progresses. The impacts on the Development Fund would be less under the typical and wetter hydrologic conditions and would decrease over the course of the operating period. These impacts would be slightly exacerbated by the decrease in economic value of electrical energy at the Parker and Davis Powerplants. Overall, the Proposed Action would result in greater impacts on the Development Fund when compared with the No Action Alternative.

The Dam Fund and Parker-Davis Account receive a set amount of revenue directly from customers and would only see minor impacts from the Proposed Action. Reduced economic value of electrical energy at the Hoover Powerplant would have impacts on the Dam Fund. The lake reservoir elevation protections at Lake Havasu and Lake Mohave allow for continued generation, capacity, and hydropower value at the Parker and Davis Powerplants. There would be a slight decrease in releases, which would impact the generation and economic value of electrical energy; this would result in minor impacts on the Parker-Davis Account.

Cumulative Effects

The potential operational changes included in LTEMP SEIS could result in a decrease in the economic value of electrical energy at the Glen Canyon Powerplant and a potential decrease in the associated contributions to the Basin Fund. The further impacts on economic value of electrical energy from the Proposed Action could deepen this decrease in value at Glen Canyon Powerplant. Overall, the Basin Fund would see a decrease in value compared with recent annual values. The LTEMP SEIS would not impact the economic value of electrical energy at the Lower Basin powerplants. Therefore, there would be no additional impacts on other Lower Basin federal accounts.

No cumulative effects on the economic value of electrical energy would occur due to the proposed management activities planned in the Salton Sea 10-Year Plan or the environmental assessment for the implementation of the 10-Year Plan's projects. No cumulative impacts would result as the Proposed Action is not adding additional impacts to those that are already occurring; however, these impacts might occur sooner under the Proposed Action.

Issue 5: How would impacts on the basin funds affect other governmental programs?

The various federal accounts provide funding for multiple governmental programs in the Upper and Lower Colorado Basin, including the Colorado River Basin Salinity Control Program, the CAP, and other projects, as directed by the Arizona Water Rights Settlements Act. The programs and projects would be directly affected by any changes in financial reserves within the federal account. Some programs are able to receive flexible funding from both Upper and Lower Basin federal accounts, which could help reduce impacts.

These impacts are difficult to model accurately; therefore, a qualitative analysis has been included based on economic value of electrical energy modeling and impacts on the federal accounts, as outlined in Issue 4.

Summary

Compared with the No Action Alternative, available funding in the Basin Fund under the Proposed Action would vary widely. Additional economic value under dry hydrologic conditions would help provide funding for the government programs that rely on funding from the Basin Fund. A decrease in economic value under wet hydrologic conditions would hinder the government programs that rely on the Basin Fund. Impacts on the Development Fund and Dam Fund are harder to analyze but would most likely be negatively affected by the Proposed Action under all hydrologic scenarios.

No Action Alternative

Under the No Action Alternative, the Basin Fund and Development Fund would be affected due to reduced economic value of electrical energy from power generation and capacity, particularly in low hydrology scenarios. These impacts would get worse over the course of the operating periods. Funding would increase over the operating period in wetter hydrologic conditions but would still be less than historic values. The Basin Fund provides funding for the Colorado River Basin Salinity Control Program. This program could see reductions in funding from the Basin Fund. The Development Fund helps fund the Colorado River Basin Salinity Control Program, the CAP, and projects as directed by the Arizona Water Rights Settlements Act. All these programs could see reductions in funding and repayment from the Development Fund.

The Dam Fund and Parker-Davis Account would be less affected under the No Action Alternative compared with the Basin and Development Funds. However, there would be slight impacts on the economic value of electrical energy and therefore contributions to the Dam Fund and the Parker-Davis Account. The Dam Fund and Parker-Davis Account help fund the Lower Colorado River the Colorado River Basin Salinity Control Program, the CAP, and projects as directed by the Arizona Water Rights Settlements Act. All these programs could see slight reductions in funding and repayment from the Dam Fund and Parker-Davis Account.

Proposed Action

Under the Proposed Action, the Basin Fund would see similar impacts compared with the No Action Alternative. Funding for the Colorado River Basin Salinity Control Program would experience decreased funding. These impacts would be greater compared with the No Action Alternative.

The Development Fund would potentially experience significant impacts on available funding. Available funding would decrease as the reservoir elevation and releases dropped. This would result in a decrease in the economic value of electrical energy and would mean funding would be reduced for the Colorado River Basin Salinity Control Program, the CAP, and other projects, as directed by the Arizona Water Rights Settlements Act. Impacts on these programs could be worse compared with the No Action Alternative.

Under the Proposed Action, the Dam Fund and Parker-Davis Account would be less affected compared with the Basin and Development Funds. However, there would be impacts on the economic value of electrical energy and therefore contributions to the Dam Fund and Parker-Davis Account. The Dam Fund and Parker-Davis Account help fund the Colorado River Basin Salinity Control Program, the CAP, and projects, as directed by the Arizona Water Rights Settlements Act.

All these programs could experience reductions in funding and repayment from the Dam Fund and Parker-Davis Account.

Cumulative Effects

The potential operational changes included in the LTEMP SEIS flow options could result in a substantial decrease in funds available in the Basin Fund and, therefore, a decrease in available funds for the governmental programs aided by the Basin Fund. The further impacts on economic value of electrical energy from the Proposed Action could worsen the decrease in funds. There would be no additional impacts on the Lower Basin funds and the governmental programs that receive funding from them.

No cumulative effects would occur on funds available in the Basin Fund due to the proposed management activities planned in the Salton Sea 10-Year Plan or the environmental assessment for the implementation of the 10-Year Plan's projects. No cumulative impacts would result as the Proposed Action is not adding additional impacts to those that are already occurring; however, these impacts might occur sooner under the Proposed Action.

Issue 6: How would impacts on the power generation affect ancillary services?

Ancillary services, such as regulation and reserve, require certain lake reservoir elevations and releases so that generation and capacity can continue at a rate that allows for up and down regulation along with the necessary reserves. Ancillary services see only minor impacts until elevations and releases drop near or below minimum power pool. If penstock releases dropped below those levels or stopped completely, these ancillary services would be negatively affected.

Hoover Dam ancillary services would be proportionately affected as lake levels and projected energy generation drop. Flexibility of release and the ability to leverage downstream storage at Davis and Parker Dams creates significant opportunities to utilize ancillaries such as regulation and reserves from Hoover Dam. Parker and Davis Dams would have minor impacts on ancillary services.

Summary

Ancillary services at Glen Canyon Dam would be affected under both the No Action Alternative and Proposed Action as reservoir elevations approached minimum power pool in low hydrologic conditions. In dry hydrologic scenarios, under the No Action Alternative, reservoir elevations at Lake Powell could drop below the minimum power pool, resulting in a complete halt of generation, capacity, and ancillary services. Ancillary services at Glen Canyon Dam would be more affected under the No Action Alternative than under the Proposed Action. The protections at Lake Powell under the Proposed Action would reduce the potential of reaching minimum power pool. Ancillary services at the Hoover Powerplant would not be substantially affected under either alternative, as lake elevations are not expected to drop near minimum power pool. Parker-Davis Powerplants would have minor impacts on ancillary services due to the lake reservoir elevation protections.

No Action Alternative

Under the No Action Alternative, penstock releases from Glen Canyon, Hoover, Parker, and Davis Dams would continue as outlined in the 2007 FEIS. Under the drier hydrologic scenarios, this could result in reservoir elevations dropping below the minimum power pool at Lake Powell. This would

result in a complete halt in ancillary services such as regulation and reserve. It may or may not be feasible for WAPA to find other facilities to make up for the decrease in regulation and reserve. Lake Mead's elevations would decrease, but not enough to impact ancillary services.

The Parker and Davis Powerplants would be able to continue with ancillary services due to the lake reservoir elevation protections. However, under the driest hydrologic conditions, these lake elevations and releases could drop to the point where ancillary services may be affected.

Under the wet hydrologic scenarios, ancillary services at all four analyzed powerplants would be able to continue.

Proposed Action

Overall, the Glen Canyon Powerplant ancillary services would be less affected under the Proposed Action than under the No Action Alternative. Protection elevations at Lake Powell would allow ancillary services to continue without a complete halt. Ancillary services at the Glen Canyon Powerplant would continue unaffected as long as minimum flows remained at approximately 1,000–2,000 cfs above minimum LTEMP regulations. If releases dropped below these levels, ancillary services would be negatively affected. If this occurs, it may or may not be feasible for WAPA to find other facilities to make up for the decrease in regulation and reserve.

Lake Mead elevations are projected to be well above minimum power pool, resulting in minimal impacts on ancillary services.

The Parker and Davis Powerplants would be able to continue with ancillary services due to the lake reservoir elevation protections. However, under the driest hydrologic conditions, these lake elevations and releases could drop to the point where ancillary services may be affected.

Under the wetter hydrologic scenarios, ancillary services at all four analyzed powerplants would be able to continue unaffected.

Cumulative Effects

The potential operational changes included in the LTEMP SEIS flow options could have substantial negative impacts on ancillary services at Glen Canyon Dam if reservoir elevations drop toward minimum power pool and releases drop below LTEMP minimums flows. Additional water could be released through the river outlet works, resulting in less generation and potentially negative impacts on regulation and reserve. The LTEMP SEIS would not impact operations at the Lower Basin powerplants. Therefore, the LTEMP SEIS would not result in any additional impacts on ancillary services at Hoover, Parker, or Davis Dams.

No cumulative effects would occur on ancillary services due to the proposed management activities planned in the Salton Sea 10-Year Plan or the environmental assessment for the implementation of the 10-Year Plan's projects. No cumulative impacts would result as the Proposed Action is not adding additional impacts to those that are already occurring; however, these impacts might occur sooner under the Proposed Action.

3.16 Socioeconomics

This section provides an overview of socioeconomic conditions in the study area. The baseline information and analysis tier off the 2007 FEIS (Reclamation 2007). In the 2007 FEIS, consumptive use was apportioned between the Upper and Lower Basins of the Colorado River and then further apportioned to individual states and entities based on a range of anticipated shortage amounts. The risk of continued drought and reservoir elevations declining below those considered likely in the 2007 FEIS requires consideration of updates to the 2007 Interim Guidelines to protect the reservoir elevations of Lake Powell and Lake Mead, as analyzed in this SEIS.

Information is provided in this document to update the analysis, as appropriate, to reflect overall changes in social and economic conditions in the Basin with the potential to be affected by management decisions and to reflect updated information on the water use levels for key use sectors and associated economic contributions. The potentially affected socioeconomic issues addressed in this section include:

- Agricultural production and the resulting changes in employment, income, and tax revenues
- Municipal and industrial uses of water and the resulting changes in economic activity
- Reservoir-related and river-related recreation and the resulting changes in employment, income, and consumer surplus value

Financial impacts from changes to hydropower availability and power costs are addressed in **Section 3.15**, Electrical Power Resources.

3.16.1 Affected Environment

Socioeconomic Study Area

The study area for this SEIS is the same as that described in the 2007 FEIS; this is due to the potential for additional water shortages throughout the Lower Division States.

The Arizona study area consists of Coconino, Gila, La Paz, Maricopa, Mohave, Pima, Pinal, and Yuma Counties (counties either directly adjacent to Lake Powell, Lake Mead, or the Colorado River, or counties in which shortages would likely occur). The counties in which measurable shortages could potentially occur, resulting in reductions in agricultural production or reduced municipal and industrial deliveries, are La Paz, Maricopa, Mohave, Pinal, Pima, and Yuma Counties. Although Coconino County would not experience a water shortage attributable to the proposed alternatives, it is included in the study area because it is adjacent to the Colorado River and may be affected by changes in recreation-related economic activity as a result of changes in river flows.

The California study area consists of Imperial, Los Angeles, Orange, Riverside, San Bernardino, and San Diego Counties. These counties were selected because they are either directly adjacent to the lower Colorado River, or they are within the MWD service area. While not adjacent to the lower Colorado River or within the MWD service area, Riverside and Imperial County are also relevant to

include because the SEIS analysis includes the Salton Sea, which has the potential to be affected by the Proposed Action. Although Ventura County is also in the MWD service area, it does not receive any water from the Colorado River; therefore, it is not included in the study area.

The Nevada study area consists of Clark County. The study area was limited to Clark County because it is adjacent to Lake Mead and encompasses the SNWA's service area. Shortages in Nevada would be limited to the SNWA's service area.

The Utah study area consists of Garfield, Kane, and San Juan Counties. Although Utah will not experience shortages under any alternative, changes in storage at Lake Powell could result in changes in recreation-related expenditures made in these counties.

Baseline Economic Conditions

This section provides an overview of baseline economic conditions related to Colorado River water use with the potential to be affected by water shortages. For additional details, refer to the 2007 FEIS.

Arizona

Population

Population is a driver of demand for consumptive water use, particularly for municipal water. Populations throughout the western US have followed increasing trends over the past decade. With the exception of La Paz County (loss of 18 percent) and Gila County (loss of 0.1 percent), Arizona study area counties follow this trend of increasing population, with the biggest increase in Pinal County (27.7 percent). **Table 3-80**, below, provides an overview.

Employment

Table 3-81, below, provides an overview for employment by sector for the counties in the study area in Arizona. Comparisons are made, where applicable, to 2004 data provided in the 2007 FEIS. Full- and part-time employment in Arizona totaled 4,055,932 jobs in 2021, an increase of approximately 1,008,389 jobs from 2004 levels. Farm employment totaled 29,309 jobs in 2021 and accounted for 0.7 percent of total employment in the state; this is the same percentage as in 2004.

Employment in the study area counties represents approximately 93 percent of total employment in Arizona. Employment in the agricultural sector in the eight counties totaled 16,349 jobs in 2021 and represented less than 1 percent of total employment in the study area counties (Bureau of Economic Analysis 2023a).

Personal Income

Total personal income in Arizona totaled just over $403.7 billion in 2021, compared with $227.9 billion in 2004 (adjusted to 2021$). Likewise, per capita income increased from approximately $40,960 in 2004 (adjusted to 2021$) to approximately $55,487 in 2021; this is a 35 percent increase (see **Table 3-82**; Bureau of Economic Analysis 2023b).

Table 3-80
Arizona Population 2010–2021

Population	Coconino County	Gila County	La Paz County	Maricopa County	Mohave County	Pima County	Pinal County	Yuma County	Arizona
Population 2010	131,824	53,272	20,549	3,751,410	199,177	964,462	329,297	190,526	6,246,816
Population 2021	144,942	53,211	16,845	4,367,186	211,274	1,035,063	420,625	202,944	7,079,203
Percent Change 2010–2021	10.0	-0.1%	-18.0	16.4	6.1	7.3	27.7	6.5	13.3

Source: Headwaters Economics Economic Profile System 2023

Table 3-81
Arizona Employment by Industry (2021)

Employment	Coconino County	Gila County	La Paz County	Maricopa County	Mohave County	Pima County	Pinal County	Yuma County	Arizona
Total employment	84,555	20,790	7,801	2,860,955	78,406	537,770	109,679	91,280	4,055,932
Wage and salary employment	64,693	15,078	6,259	2,202,144	56,716	404,217	68,886	73,885	3,076,770
Proprietors' employment	19,862	5,712	1,551	658,811	21,690	130,553	40,793	17,395	979,162
Farm employment (number and percentage of total employment)	2,117	177	458	6,453	520	1,161	2,287	3,353	29,309
	2.5%	0.9%	5.9%	0.2%	0.7%	0.2%	2.1%	19.1%	0.7%
Non-farm employment (number and percentage of total employment)	82,438	20,613	7,352	2,854,520	77,886	533,609	107,392	87,927	4,026,623
	97.5%	99.1%	94.1%	99.8%	99.3%	99.8%	97.9%	80.9%	99.3%

Employment	Coconino County	Gila County	La Paz County	Maricopa County	Mohave County	Pima County	Pinal County	Yuma County	Arizona
Employment by Industry (Number and Percentage of Total Employment)									
Forestry, fishing, and related	266	101	D	2,553	D	490	572	7,157	13,832
	0.3%	0.5%	D	0.1%	D	0.1%	0.5%	7.8%	0.3%
Mining, quarrying, and oil and gas extraction	142	941	59	6,453	445	3,300	1,256	88	17,894
	0.2%	4.5%	0.8%	0.2%	0.6%	0.6%	1.1%	0.1%	0.4%
Utilities	196	66	21	8,309	405	2,095	332	165	12,720
	0.2%	0.3%	0.8%	0.3%	0.5%	0.4%	0.3%	0.2%	0.3%
Construction	4,034	1,306	184	184,242	6,557	28,062	6,283	4,920	253,184
	4.8%	6.3%	2.4%	6.4%	8.4%	5.2%	5.7%	5.4%	6.2%
Manufacturing	3,661	1,326	257	141,468	3,401	29,734	5446	3,044	195,722
	4.3%	6.4%	3.3%	4.9%	4.3%	5.6%	5.0%	2.1%	4.8%
Wholesale trade	1,204	173	130	92,909	1,691	8,857	1,944	1,925	115,142
	1.4%	0.8%	1.7%	3.2%	2.2%	1.7%	1.8%	2.1%	2.8%
Retail trade	8,669	2,375	1,673	282,511	12,180	52,464	14,072	9,909	413,565
	10.3%	11.4%	21.4%	9.9%	15.5%	9.8%	12.8%	10.9%	10.2%
Transportation and warehousing	2,384	486	193	169,998	2,960	28,933	6,359	3,220	224,294
	2.8%	2.3%	2.5%	5.9%	3.8%	5.4%	5.8%	3.5%	5.5%
Information	645	135	87	48,230	656	6,653	872	482	59,769
	0.8%	0.6%	1.1%	1.7%	0.8%	1.2%	0.8%	0.5%	1.5%
Finance and insurance	1,962	658	D	243,962	2,808	24,871	4,315	3,692	290,236
	2.3%	3.2%	D	8.5%	3.6%	4.7%	3.9%	4.0%	7.2%
Real estate rental and leasing	4,147	1,068	D	172,770	4,821	28,896	5,946	3,143	234,832
	4.9%	5.1%	D	7.3%	6.1%	5.4%	5.4%	3.4%	5.8%
Professional, scientific, and technical services	3,735	777	D	39,192	2,909	33,399	5,017	3,709	269,961
	4.4%	3.7%	D	1.4%	3.7%	6.2%	4.6%	4.1%	6.7%
Management of companies and enterprises	468	D	D	244,023	222	2,726	434	353	44,165
	0.6%	D	D	8.5%	0.3%	0.5%	0.4%	0.4%	1.1%

Employment	Coconino County	Gila County	La Paz County	Maricopa County	Mohave County	Pima County	Pinal County	Yuma County	Arizona
Administrative, support, and waste management	2,626	D	150	65,739	4,211	37,001	7,968	6,191	313,831
	3.1%	D	1.9%	2.3%	5.4%	6.9%	7.3%	6.8%	7.7%
Educational services	1,075	189	D	325,464	805	9,300	2,205	697	85,070
	1.3%	0.9%	D	11.4%	1.0%	1.7%	2.0%	0.8%	2.1%
Health care and social assistance	9,627	1,698	D	56,772	9,491	70,081	7,241	9,221	459,980
	11.4%	8.2%	D	2.0%	12.1%	13.1%	6.6%	10.1%	11.3%
Arts, entertainment, and recreation	3,083	375	D	56,772	D	11,588	2,676	683	81,541
	3.6%	1.8%	D	2.0%	D	2.2%	2.4%	0.7%	2.0%
Accommodation and food services	13,716	1,806	D	193,676	9,572	38,277	7,385	7,055	293,749
	16.2%	8.7%	D	6.8%	12.2%	7.2%	6.7%	7.7%	7.2%
Other services	3,695	977	D	135,811	5,109	29,315	6,872	4,148	200,894
	4.4%	4.7%	D	4.7%	6.5%	5.5%	6.3%	4.5%	5.0%
Government and government enterprises	17,103	5,407	2,022	234,204	8,352	87,567	20,197	18,125	446,242
	20.2%	26.0%	25.9%	8.2%	10.7%	16.4%	18.4%	19.9%	11.0%

Source: Bureau of Economic Analysis 2023a

D = not shown to avoid disclosure of confidential information; estimates are included in higher-level totals.

Table 3-82
Arizona Personal Income and Earnings (2021)

Income/Earnings	Coconino County	Gila County	La Paz County	Maricopa County	Mohave County	Pima County	Pinal County	Yuma County	Arizona
Personal income ($1,000s)	$8,255,426	$2,612,568	$819,303	$268,713,717	$8,997,444	$55,696,681	$19,687,597	$9,169,548	$403,739,312
Per capita personal income	$56,914	$48,752	$49,933	$59,759	$41,331	$52,942	$43,793	$44,299	$55,487
Earnings by place of work	$4,633,046	$1,050,392	$365,268	$192,958,723	$3,807,031	$31,731,662	$5,182,726	$5,472,861	$258,941,005
Wages and salaries	$3,154,528	$763,967	$281,717	$146,954,704	$2,626,349	$22,652,731	$3,512,696	$3,732,656	$193,197,269
Supplements to wages and salaries	$810,341	$194,781	$72,577	$27,989,246	$591,791	$5,328,512	$870,907	$1,013,969	$39,417,203
Proprietors' income	$668,177	$91,644	$10,974	$18,014,773	$588,891	$3,750,419	$799,123	$726,236	$26,326,533

Source: Bureau of Economic Analysis 2023b

Among the eight counties, average per capita income ranged from a low of approximately $41,331 per year in La Paz County to a high of $59,759 per year in Maricopa County. Only Maricopa and Coconino Counties had per capita income above the state of Arizona average ($55,487). The total personal income generated in the eight counties represented around 93 percent of the state total (Bureau of Economic Analysis 2023b).

Agriculture

Approximately 36 percent of Arizona's land area in 2018 was used for agricultural purposes (either crop or livestock production). According to an agricultural economic profile on Arizona counties for 2017 (Duval et al. 2020)[20], the total market value of agricultural production in Arizona contributed $23.3 billion to Arizona's economy. Direct contributions from the sale of farm products; the manufacture of crop inputs; and crop processing, marketing, and distribution accounted for $14.8 billion, with an additional $8.5 billion coming indirectly from economic activity generated as a result of agricultural income (Lahmers and Edan 2018). The types of crops, amount of water used for agriculture, and the role of agriculture in county economics vary across the state. The top agricultural industries by employment include citrus, hay farming, cotton farming, and crop harvesting (Lahmers and Edan 2018).

Central and southwestern Arizona have long been the center of agricultural production in Arizona; central and southwestern Arizona farms contribute the largest share of agricultural production in terms of sales values. In 2017, the market value of agricultural production occurring within the Arizona study area accounted for nearly 62 percent of the statewide on-farm agricultural production value and 0.41 percent of Arizona total gross domestic product (GDP). In 2017, production values ranged from a low of approximately $17.1 million in La Paz County to a high of $1.2 billion in Yuma County (Duval et al. 2020). **Table 3-83** presents a summary of the market value of on-farm agricultural production with respect to county and state GDP.

In the western US, while agriculture represents a relatively small share of the US production, it requires large amounts of irrigation water. The most water-intensive crops include crops for food, feed, and fiber production. In Arizona, irrigated agriculture accounts for about 75 percent of the state's water use; more than 50 percent of this is from surface waters. According to the 2007 FEIS, urbanization of agricultural lands and heavy investment by the irrigated agricultural industry in conservation measures both on farms and in the delivery system have resulted in a reduction in the percentage (from as high as 90 percent) of water used by agricultural irrigation. Improvements in irrigation technology; voluntary fallowing programs that compensate farmers who reduce water consumption; and utilization of more effective irrigation strategies, such as changes to irrigation timing, have resulted in a reduction in agriculture's share of water consumption (Lahmers and Edan 2018).

[20] The 2017 agricultural census from the National Agricultural Statistics Service (used in reports developed by Duval et al. 2020) provides the most recent available data on the market value of agricultural production at the county level. The next agricultural census data release is due in the spring/summer 2024.

Table 3-83
Market Value of On-Farm Agricultural Production in Arizona Study Area (2017)[1]

Area	Market Value of Production ($1,000,000)	Percentage of County GDP	Percentage of Arizona GDP
Maricopa County	89.4	0.04	0.03
Pima County	64.5	0.14	0.02
Pinal County	28.1	0.37	0.01
Total within CAP Counties	**182.0**	**0.06**	**0.05**
La Paz County	17.1	2.55	0.00
Mohave County	27	0.47	0.01
Yuma County	1,200	14.46	0.34
Total within Arizona Study Area[2]	**1,426.1**	**0.45**	**0.41**

Source: Duval et al. 2020

Note: CAP values are aggregated values of Maricopa, Pima, and Pinal Counties.

[1] The 2017 agricultural census from the National Agricultural Statistics Service (used in reports developed by Duval et al. 2020) provides the most recent available data on the market value of agricultural production at the county level. The next agricultural census data release is due in the spring/summer 2024.

[2] Coconino County is included in the Arizona study area due to the potential for recreation-related impacts, but it currently does not receive Colorado River irrigation water and is excluded from this table.

Agricultural lands receiving water for irrigation from the CAP are generally within Pinal, Maricopa, and Pima Counties. The three counties account for approximately 50 percent of statewide irrigated and harvested cropland (USDA 2019a). These three counties also account for approximately 70 percent of Arizona's harvested cotton acreage, 50 percent of the state's hay crops, and approximately 44 percent of irrigated wheat cultivation (USDA 2019a).

Agricultural resources in western Arizona are primarily along the Colorado River in Mohave, La Paz, and Yuma Counties and along the Gila River Valley in Yuma County. These three western Arizona counties account for approximately 54 percent of statewide irrigated wheat cultivation, 76 percent of vegetable crops, and 36 percent of hay crops (USDA 2019a). Yuma County alone produces 75 percent of the state's total vegetable crops. **Table 3-84** provides a summary of county-wide irrigated agricultural lands within the Arizona study area.

Table 3-85 shows changes between 2012 and 2017 in acres of irrigated cropland compared with changes to acres of total cropland in each county. In general, there is a correlation between the percent change in irrigated cropland and the percent change in total cropland within the CAP counties. Changes can be due to changing cropping patterns or technological and farming strategy modifications that contribute to expansion of nonirrigated agriculture in Arizona, where irrigation would otherwise be essential. For example, an increase in total Yuma County cropland between 2012 and 2017 was due to expansion of nonirrigated cropland (USDA 2019a).

Table 3-84
Irrigated Acres of Harvested Agriculture in the Arizona Study Area (2017)[1]

Area	Irrigated Cropland (Acres)	Total Cropland (Acres)	Percent Irrigated Cropland
Maricopa County	177,975	187,467	95
Pima County	29,154	29,192	100*
Pinal County	231,092	235,185	98
Total within CAP Counties	**438,221**	**451,844**	**97**
La Paz County	(D)	96,204	(D)
Mohave County	20,713	22,002	94
Yuma County	181,244	193,823	94
Total Arizona[2]	**876,272**	**915,647**	**96**

Source: USDA 2019a

Note: CAP values are aggregated values of Maricopa, Pima, and Pinal Counties. Totals for the Arizona study area are not presented due to a lack of data for some counties.

* Percent irrigated cropland is 99.9 percent of total cropland in Pima County.

(D) = data determined too sensitive to disclose.

[1] The 2017 agricultural census from the National Agricultural Statistics Service (used in reports developed by Duval et al. 2020) provides the most recent available data on the market value of agricultural production at the county level. The next agricultural census data release is due in the spring/summer 2024.

[2] Coconino County is included in the Arizona study area due to the potential for recreation-related impacts, but it does not receive Colorado River irrigation water and is excluded from this table.

Table 3-85
Irrigation Trend for Harvested Agriculture in the Arizona Study Area (2012–2017)[1]

Area	Percent Change in Irrigated Cropland	Percent Change in Total Cropland
Maricopa County	-6.6	-4.9
Pima County	1.7	1.6
Pinal County	4.1	3.6
Total within CAP Counties	**-0.7**	**-0.2**
La Paz County	(D)	-7.6
Mohave County	(D)	(D)
Yuma County	0.0	5.1
Total Arizona[2]	**2.6**	**2.9**

Source: USDA 2019a

Note: CAP values are aggregated values of Maricopa, Pima, and Pinal Counties. Totals for the Arizona study area are not presented due to a lack of data for some counties.

(D) = data withheld in USDA 2019a source document to avoid disclosing data for individual farms.

[1] The 2017 agricultural census from the National Agricultural Statistics Service (used in reports developed by Duval et al. 2020) provides the most recent available data on the market value of agricultural production at the county level. The next agricultural census data release is due in the spring/summer 2024.

[2] Coconino County is included in the Arizona study area due to the potential for recreation-related impacts, but it does not receive Colorado River irrigation water and is excluded from this table.

Table 3-86 shows the proportion of irrigation water that comes from all surface water resources in each county. In general, there is a correlation between the trend in the change of the percentage of irrigation water that comes from surface waters and the trend in total acre-feet of surface water used for irrigating croplands. However, all or part of the change in the volume of irrigation water from surface water resources may be due to changes in contributions from groundwater. In Mohave County, although the percentage of irrigated cropland sourced from surface waters decreased from 75 percent in 2010 to 56 percent by 2015, the total acres of irrigated cropland receiving surface water increased by 14 percent. Between 2010 and 2015, Mohave County's total water usage, which includes groundwater sources in addition to surface waters, increased more rapidly than the increase in acre-feet of water from surface waters alone. The proportion from surface water's contribution decreased.

Table 3-86
Percent Irrigated Water from Surface Water Sources

Area	Percent Agricultural Water from Surface Waters (2010)	Percent Agricultural Water from Surface Waters (2015)[1]	Percent Change in Acre-Feet of Irrigation Water from Surface Waters (2010–2015)
Maricopa County	27	21	-22
Pima County	33	39	18
Pinal County	76	62	-18
Total within CAP Counties	**51**	**39**	-24
La Paz County	92	87	-5
Mohave County	75	56	-25
Yuma County	85	90	6
Total within Arizona Study Area[2]	**70**	**61**	-13
Total Arizona	**64**	**57**	**-11**

Source: USGS 2015

Note: CAP values are aggregated values of Maricopa, Pima, and Pinal Counties. Surface water sources include all sources; they are not exclusive to the Colorado River.

[1] The 2015 USGS water use (for specific purposes, such as irrigation) data by source (surface water or groundwater, etc.) are the most recent available county-level data.

[2] Coconino County is included in the Arizona study area due to the potential for recreation-related impacts, but it does not receive Colorado River irrigation water and is excluded from this table.

Industrial and Municipal Water Uses

In models of water yield and demand in the western US to 2070, data indicate that demands for municipal water are increasing across the SEIS socioeconomic study area, while projected water availability is decreasing (see, for example, Warziniack and Brown 2019). While this trend is seen throughout the western US, the Colorado River region has the largest percentage increases in projected domestic water use as well as the greatest percentage decreases in projected water yield from all sources, including Colorado River water (Warziniack and Brown 2019).

As described in the 2007 FEIS, municipalities potentially affected by the proposed alternatives include Phoenix, Tucson, Scottsdale, and other Arizona towns and cities served by the CAP, as well as Arizona municipalities along the Colorado River that have post-1968 Colorado River water

delivery contracts, such as Lake Havasu City. In Arizona, industrial land uses on the Colorado River include the major power facilities of Glen Canyon Dam in Coconino County, Hoover and Davis Dams on the Arizona-Nevada border in Mohave County (and Clark County, Nevada) and Parker Dam in La Paz County (and San Bernardino County, California).

California

Population

In California, the population has increased by approximately 7.7 percent in the past decade. With the exception of Los Angeles, the study area counties' growth all surpassed that of the state. The largest increase in population was in Riverside County (14.2 percent; see **Table 3-87**).

Table 3-87
California Population 2010–2021

Population	Imperial County	Los Angeles County	Orange County	Riverside County	San Bernardino County	San Diego County	California
Population 2010	168,052	9,758,256	2,965,525	2,109,464	2,005,287	3,022,468	36,637,290
Population 2021	180,051	10,019,635	3,182,923	2,409,331	2,171,071	3,296,317	39,455,353
Percent change 2010–2021	7.1	2.7	7.3	14.2	8.3	9.1	7.7

Source: Headwaters Economics Economic Profile System 2023

Employment

Full- and part-time employment in California totaled 23.9 million jobs in 2021, an increase of approximately 3.9 million jobs from 2004 levels. Full- and part-time employment in the six-county study area totaled 13 million jobs in 2021, representing 55 percent of total California employment. Farm employment was higher in Imperial County (5.2 percent) than in California overall (1.0 percent) and lower in all other counties (see **Table 3-88**).

Table 3-88
California Employment by Industry (2021)

Employment	Imperial County	Los Angeles County	Orange County	Riverside County	San Bernardino County	San Diego County	California
Total employment	82,115	6,428,159	2,253,070	1,127,161	1,122,017	2,131,117	23,906,353
Wage and salary employment	67,229	4,597,519	1,675,102	813,146	858,597	1,619,417	17,891,462
Proprietors' employment	14,886	1,830,640	577,968	314,015	263,420	511,700	6,014,891
Farm employment	4,229	4,110	1,363	7,293	2,467	10,820	229,419
(number and percentage of total employment)	5.2%	0.1%	0.1%	0.6%	0.2%	0.5%	1.0%

Employment	Imperial County	Los Angeles County	Orange County	Riverside County	San Bernardino County	San Diego County	California
Non-farm employment (number and percentage of total employment)	77,886	6,424,049	2,251,707	1,119,868	1,119,550	2,120,297	23,676,934
	94.8%	99.9%	99.9%	99.4%	99.8%	99.5%	99.0%
Forestry, fishing, and related	6,934	2,747	1,327	6,950	1,153	3,030	250,669
	8.4%	<0.0%	0.1%	0.6%	0.1%	0.1%	1.0%
Mining, quarrying, and oil and gas extraction	395	5,738	2,436	1,689	1,351	1,810	33,528
	0.5%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Utilities	525	13,326	3,403	1,903	3,898	5,465	65,390
	0.6%	0.2%	0.2%	0.2%	0.3%	0.3%	0.3%
Construction	2,501	252,952	132,853	98,788	60,656	113,440	1,253,884
	3.0%	3.9%	5.9%	8.8%	5.4%	5.3%	20.8%
Manufacturing	2,532	341,233	158,005	49,600	56,632	123,412	1,375,410
	3.1%	5.3%	7.0%	4.4%	5.0%	5.8%	5.8%
Wholesale trade	2,222	242,952	90,733	32,519	48,346	51,850	731,178
	2.7%	3.8%	4.0%	2.9%	4.3%	2.4%	3.1%
Retail trade	9,604	520,666	185,913	120,232	112,569	176,273	2,031,941
	11.7%	8.1%	8.3%	10.7%	10.0%	8.3%	8.5%
Transportation and warehousing	3,686	398,305	73,131	104,835	163,147	83,983	1,371,207
	4.5%	6.2%	3.2%	9.3%	14.5%	3.9%	5.7%
Information	D	252,429	30,588	8,228	6,621	28,470	643,367
	D	3.9%	1.4%	0.7%	0.6%	1.3%	2.7%
Finance and insurance	1,896	320,290	166,014	42,930	37,784	106,550	1,191,722
	2.3%	5.0%	7.4%	3.8%	3.4%	5.0%	5.0%
Real estate rental and leasing	1,962	393,202	157,319	53,359	42,016	115,531	1,250,434
	2.4%	6.1%	7.0%	4.7%	3.7%	5.4%	5.2%
Professional, scientific, and technical services	2,021	520,666	220,542	52,231	46,030	232,087	2093532
	2.5%	8.1%	9.8%	4.6%	4.1%	10.9%	8.8%
Management of companies and enterprises	178	77,980	42,667	4,674	5,587	27,703	277,998
	0.2%	1.2%	1.9%	0.4%	0.5%	1.3%	1.1%
Administrative, support, and waste management	3,459	406,452	198,480	85,653	89,927	132,174	1,526,406
	4.2%	6.3%	8.8%	7.6%	8.0%	6.2%	6.4%
Educational services	387	172,964	53,545	14,692	16,275	46,095	543,623
	0.5%	2.7%	2.4%	1.3%	1.5%	2.2%	2.3%
Health care and social assistance	11,023	855,509	159,818	129,950	134,728	218,439	2,822,918
	13.4%	13.3%	7.1%	11.5%	12.0%	10.2%	11.8%
Arts, entertainment, and recreation	348	223,083	56,418	22,842	14,023	47,031	566,938
	0.4%	3.5%	2.5%	2.0%	1.2%	2.2%	2.4%
Accommodation and food services	4,452	408,321	159,818	86,805	14,023	152,988	1,575,223
	5.4%	6.4%	7.1%	7.7%	1.2%	7.2%	6.6%
Other services	D	414,016	123,440	72,847	73,055	115,935	1,346,871
	D	6.4%	5.5%	6.5%	6.5%	5.4%	5.6%
Government and government enterprises	19,271	600,175	160,559	129,141	65,928	338,030	2,724,695
	23.5%	9.3%	7.1%	11.5%	5.9%	15.9%	11.4%

Source: Bureau of Economic Analysis 2023a

D = not shown to avoid disclosure of confidential information; estimates are included in higher-level totals.

Personal Income

Total personal income in California totaled $3 trillion in 2021, compared with $1.84 trillion in 2004 (when adjusted for inflation). Statewide per capita income also increased from approximately $49,435 in 2004 (adjusted for inflation) to approximately $76,614 in 2021 (Bureau of Economic Analysis 2023b; see **Table 3-89**).

In 2004, total personal income ranged from a low of approximately $8.6 billion in Imperial County to a high of $728.8 billion in Los Angeles County. When combined, the total personal income of the six counties represents 48.8 percent of the state total. Per capita income ranged from a low of approximately $47,653 in Imperial County to a high of approximately $81,034 in Orange County.

Table 3-89
California Personal Income and Earnings (2021)

Income/ Earnings	Imperial County	Los Angeles County	Orange County	Riverside County	San Bernardino County	San Diego County	California
Personal income ($1,000s)	$8,570,390	$728,772,915	$256,700,438	$125,820,553	$108,623,799	$238,691,713	$3,006,183,929
Per capita personal income	$47,653	$74,141	$81,034	$51,180	$49,493	$72,637	$76,614
Earnings by place of work	$5,137,777	$510,862,232	$181,016,988	$64,353,758	$69,548,586	$167,563,948	$2,102,644,661
Wages and salaries	$3,249,301	$359,122,730	$128,811,520	$45,029,294	$49,466,149	$123,893,955	$1,533,988,242
Supplements to wages and salaries	$1,122,878	$78,557,777	$26,652,410	$11,516,385	$12,705,654	$29,637,025	$314,285,006
Proprietors' income	$765,598	$73,181,725	$25,553,058	$7,808,079	$7,376,783	$14,032,968	$254,371,413

Source: Bureau of Economic Analysis 2023b.

Agriculture

The percentage of cropland that is irrigated in the California study area, with an average of 94 percent—which is the same as the percentage of irrigated cropland for all of California—varies across the different counties. The percentage of irrigated cropland ranges from a low of 68 percent in Orange County to a high of 98 percent in Imperial County. The proportion of irrigated croplands within the California study area represents approximately 12 percent of total irrigated croplands in the state. **Table 3-90** shows acres of irrigated and total cropland within the California study area.

Table 3-90
Irrigated Acres of Harvested Agriculture in the California Study Area (2017)[1]

Area	Irrigated Cropland (Acres)	Total Cropland (Acres)	Percent Irrigated Cropland
Imperial County	455,768	467,445	98
Los Angeles County	10,104	12,806	79
Orange County	3,946	5,803	68
Riverside County	125,363	143,628	87

Area	Irrigated Cropland (Acres)	Total Cropland (Acres)	Percent Irrigated Cropland
San Bernardino County	21,487	22,145	97
San Diego County	41,607	49,080	85
Total California Study Area	**876,272**	**915,647**	**94**
California	**7,348,690**	**7,857,512**	**94**

Source: USDA 2019b

[1] The 2017 agricultural census from the National Agricultural Statistics Service (used in reports developed by Duval et al. 2020) provides the most recent available data on the market value of agricultural production at the county level. The next agricultural census data release is due in the spring/summer 2024.

Industrial and Municipal Water Uses

As noted in the 2007 FEIS, municipalities potentially affected by the proposed alternatives include 88 cities in Los Angeles County, 34 cities in Orange County, 24 cities in Riverside County, 31 cities in San Bernardino County, and 18 cities in San Diego County.

Nevada

Population

Following trends seen in other study area states, the population of Nevada grew by over 16 percent from 2010 through2021. Clark County's population change (17.7 percent) was higher than that of the state overall (see **Table 3-91**).

Table 3-91
Nevada Population 2010–2021

Population	Clark County	Nevada
Population 2010	1,895,521	2,633,331
Population 2021	2,231,147	3,059,238
Percent Change 2010–2021	17.7	16.2

Source: Headwaters Economics Economic Profile System 2023

Employment

Full- and part-time employment in Nevada totaled 1,875,709 jobs in 2021, an increase of approximately 472,402 jobs from 2004 levels. In 2021, employment in the arts, entertainment, and recreation sector totaled 55,322 jobs, or approximately 3 percent of total employment in the state. Farm employment represented only 0.3 percent of total employment.

Full- and part-time employment in Clark County totaled 1,368,492 jobs in 2021, an increase of approximately 370,492 jobs from 2004. Total employment in Clark County represented almost 70 percent of total employment in Nevada. In 2021, employment in the arts, entertainment, and recreation sector totaled 41,400 jobs, or approximately 3 percent of total employment in the county. Similar to statewide totals, farm employment represented only 0.03 percent of total employment. See **Table 3-92**.

Table 3-92
Nevada Employment by Industry (2021)

Employment	Clark County	Nevada
Total employment	1,368,492	1,875,709
Wage and salary employment	1,019,149	1,409,465
Proprietors' employment	349,343	466,244
Farm employment (number and percentage of total employment)	409 0.03%	5,028 0.3%
Non-farm employment (number and percentage of total employment)	1,368,083 >99.9%	1,870,681 99.7%
Forestry, fishing, and related	457 <0.0%	1,937 0.1%
Mining, quarrying, and oil and gas extraction	1,577 0.1%	4,526 0.2%
Utilities	86,255 6.3%	4,526 0.2%
Construction	86,255 6.3%	120,249 6.4%
Manufacturing	29,758 2.2%	66,978 3.6%
Wholesale trade	29,275 2.1%	43,982 2.3%
Retail trade	136,244 10.0%	185,306 9.9%
Transportation and warehousing	104,271 7.6%	137,427 7.3%
Information	15,961 1.2%	21,137 1.1%
Finance and insurance	80,765 5.9%	103,909 5.5%
Real estate rental and leasing	79,184 5.8%	110,419 5.9%
Professional, scientific, and technical services	79,184 5.8%	109,638 5.8%
Management of companies and enterprises	79,597 5.8%	32,573 1.7%
Administrative, support, and waste management	26,541 1.9%	132,423 7.1%
Educational services	16,473 1.2%	21,845 1.2%
Health care and social assistance	118,625 8.7%	160,792 8.6%
Arts, entertainment, and recreation	41,400 3.0%	55,322 2.9%

Employment	Clark County	Nevada
Accommodation and food services	229,369	276,961
	16.8%	14.8%
Other services	67,012	89,948
	4.9%	4.8%
Government and government enterprises	119,106	177,141
	8.7%	9.4%

Source: Bureau of Economic Analysis 2023a

Personal Income

Total personal income in Nevada totaled $189.3 billion in 2021, an 89 percent increase over 2004 levels (when adjusted for inflation). Statewide per capita income increased from approximately $23,800 in 1994 (inflation-adjusted levels) to approximately $33,800 in 2004. See **Table 3-93.**

In 2021, per capita income in Clark County was $58,276, which was slightly lower than the state average. The total personal income of Clark County represents more than 70 percent of the state total. See **Table 3-93**.

Table 3-93
Nevada Personal Income and Earnings (2021)

Income/Earnings	Clark County	Nevada
Personal income ($1,000s)	$133,596,955	$189,308,244
Per capita personal income	$58,276	$ 60,213
Earnings by place of work	$83,182,161	$117,154,278
Wages and salaries	$60,447,133	$ 84,993,156
Supplements to wages and salaries	$13,352,162	$ 19,168,471
Proprietors' income	$9,382,866	$ 12,992,651

Source: Bureau of Economic Analysis 2023b
(D) = Not shown to avoid disclosure of confidential information; estimates are included in higher-level totals.

Agriculture

Agriculture in the Nevada study area was relatively small (2,722 acres, which are less than 0.01 percent of the agricultural study area) compared with the agricultural areas in Arizona and California study areas. The Nevada agricultural study area was also relatively small (0.5 percent) compared with total agricultural cropland in the state. Of the total harvested agricultural lands in Clark County, which makes up the Nevada study area, 100 percent were irrigated cropland, which is comparable with the percentage of irrigated cropland in Nevada (99 percent). **Table 3-94** shows the acres of irrigated and total cropland within the Nevada study area.

Table 3-94
Irrigated Acres of Harvested Agriculture in the Nevada Study Area (2017)[1]

Area	Irrigated Cropland (Acres)	Total Cropland (Acres)	Percent Irrigated Cropland
Clark County	2,722	2,722	100
Total Nevada	**567,978**	**573,785**	**99**

Source: USDA 2019c

[1] The 2017 agricultural census from the National Agricultural Statistics Service (used in reports developed by Duval et al. 2020) provides the most recent available data on the market value of agricultural production at the county level. The next agricultural census data release is due in the spring/summer 2024.

Municipal and Industrial Water Use

As noted in the 2007 FEIS, municipalities potentially affected by the proposed alternatives include Boulder City, Henderson, Las Vegas, and North Las Vegas due to their reliance on Colorado River water supplied by SNWA.

Utah

Reclamation does not anticipate that the counties in the Utah study area would be affected by agricultural, industrial, or municipal water shortages as a result of proposed management. As a result, no detailed information is included for the population, employment, and income, or the agriculture, municipal, or industrial uses in the study area.

Economic Contributions from Recreation

As discussed in **Section 3.14**, Recreation, recreational activities with the potential to be affected by proposed management include recreation (boating, camping, hiking, etc.) on and adjacent to reservoirs at Lake Powell and Lake Mead, as well as river-based recreation downstream in Glen Canyon and Grand Canyon. Information is also included on wildlife refuges on the Colorado River; these refuges may be affected by the Proposed Action.

Economic benefits result when visitors spend dollars on recreation. Those benefits include increased sales, income, and jobs. Direct economic benefits occur when businesses sell goods and services to area visitors. Additional jobs and economic activity are supported when businesses purchase supplies and services from other local businesses, thus creating indirect effects from visitor spending. In addition, employees use their income to purchase goods and services in the local economy, generating further induced effects from visitor spending.

Table 3-95, below, displays the total economic contributions from recreation occurring in the GCNRA, LMNRA, and GCNP. Information is included in **Table 3-95** related to economic contributions from wildlife refuges. Economic contributions are estimated by multiplying total visitor spending by regional economic multipliers. Total visitor spending includes spending by both local visitors who live in gateway regions and nonlocal visitors who travel to NPS sites from outside gateway regions. Spending by nonlocal visitors represents an influx of dollars from outside the local economy. In addition, nonlocal visitors typically have higher levels of spending on food, lodging, and other activities on a per-trip basis.

Table 3-95
Summary of Economic Contributions for NPS-Based Recreation (2021)

NPS Unit	Total Recreation Visits	Visitor Spending (1,000s of 2021$)	Jobs	Labor Income (1,000s of 2021$)	Value Added (1,000s of 2021$)	Economic Output (1,000s of 2021$)	% of Spending from Nonlocals
GCNRA	3,144,318	$332,150	3,839	$139,418	$234,458	$409,546	96
GCNP	4,352,667	$710,256	9,390	$324,318	$539,433	$944,693	99
LMNRA	7,603,474	$373,668	4,054	$167,550	$281,033	$457,279	88

Source: NPS 2022d

Note: Jobs measure annualized full- and part-time jobs that are supported by NPS visitor spending. Labor income includes employee wages, salaries, and payroll benefits, as well as proprietors' incomes that are supported by NPS visitor spending. Value added measures the contribution of NPS visitor spending to the GDP of a regional economy. Value added is equal to the difference between the amount an industry sells a product for and the production cost of the product. Economic output is a measure of the total estimated value of the production of goods and services supported by NPS visitor spending. Economic output is the sum of all intermediate sales (business to business) and final demand (sales to consumers and exports).

The GCNRA, LMNRA, and GCNP had 96 percent, 88 percent, and 99 percent of spending from nonlocal visitors, respectively. A discussion of recreation-related economic activity occurring on the Colorado River downstream of Lake Powell and Lake Mead was not included; this is because no change in recreation and resulting changes in economic activity are expected under the proposed alternatives. For additional details on recreation and levels of use, see **Section 3.14**, Recreation.

As shown in **Table 3-96**, below, recreational visits to the GCNRA and GCNP correspond with a wide array of job sectors within local (predominately small town and rural) economies. In 2021, GCNRA recreation supported 3,839 jobs, including 921 indirect and induced jobs. GCNP recreation supported 9,390 jobs, including 2,243 indirect and induced jobs (NPS 2022d). LMNRA recreation supported 4,054 total jobs in 2021 (specific job data unavailable).

Table 3-96
Jobs by Sector Supported by Economic Contributions from NPS-Based Recreation (2021)

Jobs	GCNRA	GCNP
Direct Jobs by Sector		
Camping	76	143
Gas	73	94
Groceries	98	127
Hotels	1,200	2,400
Recreation industries	610	1,880
Restaurants	580	1,500
Retail	155	439
Transportation	126	564
Indirect and Induced Jobs	**921**	**2,243**
Total Jobs	**3,839**	**9,390**

Source: NPS 2022d

In addition to general recreation sector contributions, visitor use supports concessionaires, including those associated with water-based recreation. Contributions from GCNRA concessioners and small business permittees are estimated at $130 million annually in gross receipts (NPS 2022e). This spending represents an important contribution to local communities in Coconino County in Arizona and Garfield, San Juan, Wayne, and Kane Counties in Utah.

In terms of river-based recreation, it is estimated that Grand Canyon river outfitters retain roughly 1,100 employees, not including the contracted transportation and training services and numerous food, sundries, and river supply vendors required to support the operations.[21]

In addition to the direct economic impact on GCNP and the NPS, it is estimated that the regional economic impact of commercial river trips sustains hundreds of additional jobs and generates millions more of additional revenue throughout the mostly rural communities and small businesses of northern Arizona and southern Utah each season. All river recreation in GCNP is regulated through the NPS CRMP (to protect the resource and the visitor experience). River trips are closely regulated, and this experience is generally reserved an average of 12–18 months in advance. River trips include approximately 22,000 visitors annually, generating more than $50 million in revenues to the region (NPS 2006a).

In terms of wildlife refuges, economic contributions are associated with recreational visitors paying for recreation through entrance fees, lodging near the refuges, and purchases from local businesses for items to pursue their recreational experience. This spending supports economic activity throughout the local economy (Caudill and Carver 2019). **Table 3-97** displays the estimated contributions from the two refuges receiving Colorado River water, Imperial NWR and Bill Williams River NWR.

Table 3-97
Economic Contributions from National Wildlife Refuges (2017 Data)

NWR	Total Recreation Visits	Total Economic Output ($1,000)	Total Employment Income ($1,000)	Total Jobs
Bill Williams River NWR (Arizona)	326,344	$11,345.3	$2,944.2	113
Imperial NWR (Arizona and California)	274,159	$11,069.8	$3,228.6	100

Source: Service 2019a, 2019b

3.16.2 Environmental Consequences

Methodology

Agriculture

The purpose of the agricultural impact assessment is to estimate the change in agricultural production as a result of a reduction of irrigation water. The change in the value of agricultural

[21] Laurie Dyer, NPS supervisory concessions management specialist in the Commercial Services Division at GCNP, personal communication provided on March 15, 2023.

production is directly related to the acres of cropland chosen to be fallowed and the estimated revenue per acre of the fallowed crop. In addition to revenue loss from agricultural products, agricultural jobs and wages would potentially be lost.

As described in **Section 3.3**, Reclamation used CRMMS to analyze water deliveries across alternatives. Modeling details for each alternative are described in **Section 3.3.4** and **Appendix D**, CRMMS Model Documentation. Additionally, as described in **Section 3.3**, Reclamation used a Shortage Allocation Model in addition to CRMMS to analyze the potential impacts of the alternatives on individual agricultural water users within each Lower Division State under different shortage scenarios.

Reclamation then applied the 2007 agricultural modeling framework, using crops' profitability in each county to determine which crops farmers are most likely to fallow in times of reduced water availability. In this analysis, water shortages are assumed to result in temporary acres of fallowed cropland during the period in which shortages would occur. While farmers may use groundwater and other surface water resources to mitigate impacts from allocated shortages, it is difficult to project exactly how individual farmers, irrigation districts, or each Lower Division State may mitigate potential future agricultural impacts from shortages. Therefore, similar to the assumption made in the 2007 FEIS, the projected change in agricultural production was based on the conservative assumption that other sources of water would not replace the estimated water shortage.

The decision to fallow lands is based on the farmer's ability to cover the variable cost of production of a given crop. If the cost of water exceeds the maximum amount a farmer can pay or if water is not available, a crop is taken out of production and the land is fallowed during the year shortages would occur. Considering crop profitability gives an indication of crops that face larger reductions compared with other crops (Dale and Dixon 1998; Frisvold et al. 2012). The least profitable crop would be fallowed first. Crops would continue to be fallowed in the order of least profitable crop, until the full volume of water shortage is offset or until the crop is completely fallowed within the county.

Reclamation acknowledges that it is difficult to project exactly how individual farmers, irrigation districts, or each Lower Division State may mitigate potential future agricultural impacts from shortages. However, for the purposes of fully analyzing potential impacts to agriculture, attributing Basin-wide net losses of surface water supply to agricultural production and fallowing enables Reclamation to quantify and monetize the full range of potential impacts. Additionally, as for hydrologic impacts to groundwater resources, the available baseline data indicate that groundwater use may increase or decrease regardless of surface water availability, and groundwater use may vary based on many factors, including state or local regulations.

Irrigated crops in the analysis area include field crops, vegetables and melons, and trees and vines. Field crops have lower earnings per acre-foot of water than other crops; therefore, they are more vulnerable to changes in water costs and shortages. Studies on fallowing patterns in the southwestern US show that field crops account for 98 to 100 percent of fallowed crops (Frisvold et al. 2012; Dale and Dixon 1998). Fallowed crops for the No Action Alternative were limited to cotton, wheat, and alfalfa. Crops considered in this analysis included irrigated crops for which data

were available; farmers may choose to fallow other crops, such as corn or other forage and grain crops, for which data were unavailable or unreliable.

Calculation of crop profitability per acre-foot of water followed the method outlined in Appendix H of the 2007 FEIS, which used the difference between revenue and the variable costs per acre of land required to grow a given crop. In the Arizona and Nevada analysis areas, calculations were updated with the most recent available data from the US Department of Agriculture[22] (USDA 2019a). County-level revenue for each crop was based on 5-year (2014 to 2018) averages of yield[23] and prices. The US Department of Agriculture does not provide recent county-level data for California; yield, acreage, and price data for the California study area between 2014 and 2018 were obtained from reports produced by each county's agricultural commissioner/weight and measures departments (Imperial County 2014, 2015, 2016, 2017, 2018b; Riverside County 2014, 2015, 2016, 2017, 2018; San Bernardino County 2014, 2015, 2016, 2017, 2018).

County-level production cost data for each crop, including the difference in irrigation cost, are not updated frequently. To capture the difference in the irrigation cost for each crop in different counties in Arizona, variable costs-of-production estimates were based on historical crop and livestock budgets developed by the University of Arizona for 1999 (University of Arizona 2001); these were the same cost-of-production data used in the 2007 analysis. For the California counties, estimates were based on budgets developed by the University of California Davis (UC Davis 2023) for a range of years (from 1970 to 2004, depending on the type of crop and the county for which it was developed). All dollar values were converted to 2022 dollars. The purpose of using the cost estimates was only to determine the order in which crops would be fallowed; the estimates are not considered an accurate measure of the current cost and return estimates.

To determine how much a farmer would be willing to pay for water before a choice is made to fallow a crop, the irrigation cost of growing each crop was added back to the calculated revenue over the variable production cost. To account for each crop's required amount of water (different for each crop), the estimated return plus irrigation cost was divided by the amount of water per acre[24] needed to grow that crop (University of Arizona 2001; UC Davis 2023). Based on this method, the order in which crops would be fallowed varied across the counties in the study area. In Arizona and Nevada, cotton is most likely to be fallowed first. In California, wheat and alfalfa would be fallowed before cotton; vegetables would be expected to be fallowed last in the entire study area.

As in the 2007 FEIS, the socioeconomic effects of changes in agricultural production in Arizona were analyzed using the IMPLAN input-output economic model. IMPLAN is a regional economic model that describes the flows from producers to intermediate and final consumers using a series of economic multipliers. The IMPLAN model describes for each county the transfers of money between all industries and institutions. This model of county-level economic interactions is used to project total changes to regional economic activity based on the direct change estimated in

[22] The most recent available yield and price data for alfalfa hay were from 2018. More recent cotton and wheat data (2019 to 2022) were available; however, for consistency across the different crops, 2018 data were the latest data used in this analysis.
[23] The cottonseed revenue estimates that were included in the 2007 model were excluded from current revenue estimates due to a lack of county-level yield data for cottonseed in Arizona.
[24] Water (per acre) required by a particular crop is assumed to be relatively constant over time.

agricultural production. In addition to the direct loss in agricultural output, reduced expenditures occur from a drop in business-to-business purchases and in reduced household expenditures. These changes, known as indirect and induced economic effects, were also estimated using IMPLAN.

This analysis of economic impacts from fallowed crops is based on an uncompensated reduction in agricultural production associated with modeled levels of shortage. System conservation included in the No Action Alternative and Proposed Action would result in a voluntary reduction of water use for agricultural purposes, for which entities would receive compensation per the details of existing agreements (under the No Action Alternative) and the states' proposed alternative (for the Proposed Action). The regional economic impacts from system conservation are discussed qualitatively.

Impact Analysis Area

Potential changes in agricultural production within the study area due to estimated shortages were quantitatively assessed for the counties expected to experience impacts; these include La Paz, Maricopa, Mohave, Pima, Pinal, and Yuma Counties in Arizona; Imperial, Riverside, and San Bernardino Counties in California; and Clark County in Nevada.

Assumptions

- Farmers would fallow irrigated crops in response to water shortages or an increased cost of irrigation.
- Farmers would fallow crops that generate the lowest returns per acre-foot of water.
- Crops have a constant profitability per acre of land and per acre-foot of water.
- Changes in the amount of irrigated crops would be the result of changes in water deliveries from the Colorado River sources; they do not involve changes to allocations or to irrigation water from groundwater or other surface water sources.
- Estimated shortages in the agricultural sector are based on the Shortage Allocation Model (**Appendix E**, Shortage Allocation Model Documentation).
- DCP contributions and ICS assumptions are consistent with the official June 2023 CRMMS simulation, as detailed in **Appendix D**.
- The Shortage Allocation Model does not account for the use or conversion of ICS to meet DCP contributions, and it models DCP contributions as shortages to Lower Division States and users.
- Shortages and required DCP contributions are distributed between Nevada and Arizona, and between California parties, as described in the 2007 Interim Guidelines and the 2019 DCPs.
- For all alternatives, available water is distributed within the CAP based on the CAP priority system, and shortage volumes are calculated relative to scheduled 2024–2026 use. Non-Indian CAP agricultural districts currently do not hold long-term CAP contacts, but they are shown as absorbing significant shortage based on their historical use of CAP excess water.
- In most cases, the contractor, subcontractor, or recipient of an allocation is shown as the entity bearing shortage, by sector. In some cases, water allocated to one contractor, subcontractor, or recipient (for example, a Tribal CAP contractor) may lease its allocation to other users (for example, to a non-Indian municipality). The Shortage Allocation Model does not replicate those arrangements, and it only provides approximate estimates at the contract

or subcontract allocation level. The CAP contractor, subcontractor, and/or parties to those arrangements would have specific decisions to make during shortage conditions to administer those arrangements that Reclamation cannot predict with sufficient certainty to analyze in this SEIS.

Impact Indicators

- Acres of fallowed cropland
- Crop profitability per acre-foot of water
- Jobs and income associated with agriculture

Recreation

A qualitative discussion is provided related to social and economic impacts from changes in recreational access and experiences as a result of changes in reservoir elevations and river flows, as discussed in **Section 3.14**, Recreation.

In addition, a discussion of net economic value changes is provided for a subset of recreational activities, including for anglers and whitewater rafters in Glen and Grand Canyons. This analysis is provided following the approach used in the recreation economic analysis for the LTEMP SEIS (Gaston et al. 2015). Models were informed from past survey research and were used to project the change in net economic value for angling in Glen Canyon and whitewater rafting in Grand Canyon; these were compared with the Proposed Action and No Action Alternative scenarios. The analysis was based on whitewater boater and angler surveys that examined different river flow scenarios to estimate the net economic value of an individual trip as a function of river flow. The function used to estimate the net economic value is for conditions where within-day fluctuations are less than 10,000 cfs, consistent with the Proposed Action and No Action Alternative.

Impact Analysis Area

The impact analysis area consists of the counties adjacent to the Colorado River from Lake Powell to the SIB.

Assumptions

Recreation spending per trip for anglers and whitewater rafting (adjusted for inflation) would follow results from willingness-to-pay surveys (Gaston et al. 2015) with variation based on river flows.

Impact Indicators

- Recreation's economic contributions

Municipal and Industrial Uses

Impacts on municipal and industrial uses of water are discussed qualitatively based on anticipated water shortages of various magnitudes, as determined under the Shortage Allocation Model. The analysis then examines whether a particular shortage event would affect the M&I sector as compared with the No Action Alternative. For example, a shortage in Arizona would affect parts of the agricultural sector first before affecting M&I uses. In contrast, a shortage in Nevada would primarily affect M&I users, because Nevada has a small agricultural sector that uses high-priority Colorado River water.

For situations likely to have an effect on the M&I sector, each state's ability to manage shortages to the M&I sector is analyzed. The M&I shortages allocated to each state are compared with the drought plans or actions that state or local agencies could institute during a shortage. The analysis then qualitatively discusses whether such drought-planning mechanisms are adequate to address shortages to the M&I sector and the existing and estimated conservation measures to be applied under the No Action Alternative and Proposed Action.

Impact Analysis Area

The analysis area for M&I water shortages is the same as the overall analysis area for socioeconomics, as described in **Section 3.15.1**.

Assumptions

The analysis is based on shortage levels as modeled in the Shortage Allocation Model, and the frequency and magnitude of shortages based on modeled CRMMS output.

Impact Indicators

- The potential for economic impacts due to shortages and depletions among and within the Lower Division States

Issue 1: How would anticipated water shortages affect economic contributions from agriculture?

Summary

Anticipated water shortages would result in a temporary increase in acres of fallowed cropland and agricultural production loss under both alternatives. The modeled agricultural production loss would in turn result in short-term impacts on the associated jobs, income, and tax revenue. The No Action Alternative has the potential to result in up to $116 million in agricultural revenue loss, $112 million in income loss from jobs lost, and $25 million in tax revenue loss. Impacts also have the potential to occur in California and Arizona under this alternative.

Under the Proposed Action, the total range of agricultural sector losses and the associated impacts on jobs, income, and tax revenue, prior to consideration of compensated SEIS conservation, would be the same as modeled under the No Action Alternative. Increased SEIS conservation would result in more compensated conservation than under the No Action Alternative (**Table 3-98**). This would offset, to some degree, the level of economic impacts associated with reduced agricultural production. There are insufficient data, however, on the degree to which this compensation would offset the regional economic impacts in the agricultural sector, due to the loss of indirect and induced jobs and income that may not be fully compensated.

In addition, the long-term preservation of reservoir levels above a critical value (dead pool) due to proposed system conservation would help limit the potential for higher levels of shortage modeled. This is anticipated to lessen the long-term (potentially permanent) economic impacts.

Table 3-98
State-Level Comparison of Modeled Conservation for Irrigation Water Users (2023–2026 af Totals)

State		No Action Alternative System Conservation	Proposed Action System Conservation
Arizona	Tribal	383,700	550,000
	Non-Tribal	36,200	138,400
California	Tribal	—	52,000
	Non-Tribal	98,200	1,582,000
Nevada	—	—	—

Source: Based on Shortage Allocation Model allocations for the type of use and CRMMS model assumptions for modeled conservation. ICS is not included due to no identified ISC for irrigated water users.

In addition, the Proposed Action would result in higher elevations at Lake Mead, with fewer traces at higher shortage tiers, as compared with the No Action Alternative, in 2025 and 2026. As a result, the potential to reach higher-tier shortage levels for domestic water users (for example, those shortages as modeled at 967,000 to 1,100,000 af) would be reduced. This would, in turn, result in a decreased potential to reach higher levels of economic impacts on the regional economy compared with the modeled impacts under the No Action Alternative.

No Action Alternative

Temporary impacts (during periods of lower water elevations) from allocated shortages under the No Action Alternative (200,000 af to 1.100 maf of water) would result in up to 98,485 acres of fallowed cropland and up to $120 million in loss of agricultural production. The impacts would be restricted to the Arizona analysis area and would be limited to field crops. Under the No Action Alternative, cotton, wheat, and hay were analyzed in detail, and impacts did not extend to additional crops. **Table 3-99** shows the total estimated acres of fallowed cropland and the reduction in the dollar value of agricultural production for different shortage volumes under the No Action Alternative.

While non-Indian agriculture is expected to experience short-term impacts for every allocated shortage amount, lower shortage volumes (between 200,000 and 533,000 af) would not result in impacts on Indian agriculture. However, for shortages greater than 617,000 af, up to $13 million in agricultural production loss would be due to fallowed Indian agricultural lands, which account for up to 11 percent of total agricultural production loss in the study area.

In the long term, if the current guidelines of the No Action Alternative remained in effect, the water levels would be expected to decline below a critical level in Lake Mead; if water levels decline below this threshold, farmers across the analysis areas in Arizona, California, and Nevada would experience long-term (potentially permanent) production loss from fallowed crops.

Table 3-99
Acres of Fallowed Cropland and the Loss of Market Value of Agricultural Production in Arizona and California – No Action Alternative

Shortage Amount (1,000 af)	Non-Indian Agriculture – Arizona		Non-Indian Agriculture – California		Indian Agriculture		Total Agriculture in the Study Area	
	Fallowed Cropland (Acres)	Change in Production Value	Fallowed Cropland (Acres)	Change in Production Value	Fallowed Cropland (Acres)	Change in Production Value	Fallowed Cropland (Acres)	Change in Production Value
200	50,067	$57,566,506	0	$0	0	$0	50,067	$57,566,506
533	74,269	$89,980,128	0	$0	0	$0	74,269	$89,980,128
617	82,482	$98,932,404	0	$0	2,456	$3,052,073	84,938	$101,984,477
867	83,065	$99,797,208	2,154	$3,367,803	5,387	$6,693,991	90,606	$109,859,002
917	83,065	$99,797,208	2,692	$4,209,854	5,387	$6,693,991	91,144	$110,701,053
967	83,065	$99,797,208	3,231	$5,051,825	5,387	$6,693,991	91,683	$111,543,024
1,017	83,065	$99,797,208	3,769	$5,893,795	5,387	$6,693,991	92,221	$112,384,994
1,100	83,895	$101,374,907	3,769	$5,893,795	10,821	$12,967,706	98,485	$120,236,408

Source: Values were calculated using input from the Shortage Allocation Model and crop profitability, according to the methodology described above.
Note: Modeling results should only be used to compare the relative magnitude of impacts that are reasonably expected to occur under the alternatives. The results are not a substitute for agricultural production loss estimates in the analysis area; the results are subject to uncertainties from built-in assumptions and data limitations.
For those Tribes identified by Reclamation to use the full or a substantial amount of their water entitlement for agricultural operations, this analysis assumed 100 percent of consumptive-use water, as well as allocated shortages, were used for irrigation; the exact proportion of water used for agricultural operations for these Tribes was not known.
Due to data limitations for Indian agriculture, such as those involving privacy concerns, particularly for Tribes where three or fewer farms for a given crop exist, estimates did not account for the full allocated shortage volumes. Therefore, economic impacts may be larger than the estimated values.

Table 3-100 provides an overview of the jobs, income, and total economic output associated with the estimated change in agricultural production value due to fallowed crops under each shortage level for the No Action Alternative. This analysis covers anticipated shortages for operating years 2024 through 2026. **Table 3-101** provides an overview of the change to tax revenue from agricultural production losses over the same period. Under the No Action Alternative, shortages and related economic impacts have the potential to occur in Arizona and California agriculture.

The estimates provided above do not account for compensated conservation. Under the No Action Alternative, existing agreements would be in place for approximately 518,100 af of irrigation user-associated water (see **Table 3-98**). Of this amount, California system conservation agreements are associated with the Palo Verde Irrigation District in Riverside and Imperial Counties (98,200 af), and Arizona conservation agreements with Tribal entities are associated with 383,700 af of water allocation. Non-Tribal system conservation agreements include approximately 36,200 af in Mohave, Yuma, and La Paz Counties.

Table 3-100
Estimated Jobs and Income under the No Action Alternative

Shortage Amount (1,000 af)	Non-Indian Agriculture – Arizona		Non-Indian Agriculture – California		Indian Agriculture		Total	
	Total Jobs	Total Income	Total Jobs	Total Income	Total Jobs	Total Income	Total Jobs	Total Income
200	657	$67,037,544	0	$0	0	$0	657	$60,442,632
533	1,082	$86,934,411	0	$0	0	$0	1,082	$86,934,411
617	1,506	$97,623,780	0	$0	31	$2,780,000	1,537	$100,403,780
867	1,539	$98,418,089	43	$1,860,665	68	$6,097,798	1,650	$106,376,552
917	1,539	$98,418,089	54	$2,325,831	68	$6,097,798	1,661	$106,841,718
967	1,539	$98,418,089	65	$2,790,997	68	$6,097,798	1,672	$107,306,884
1,017	1,539	$98,418,089	75	$3,256,163	68	$6,097,798	1,682	$107,772,050
1,100	1,525	$100,082,619	75	$3,256,163	88	$8,368,185	1,688	$111,706,967

Source: Agricultural model output and IMPLAN 2021 software and data
Note: Total jobs include direct, indirect, and induced jobs. Due to model limitations and market uncertainties, modeling results should only be used to compare the relative magnitude of impacts that are reasonably expected to occur under the alternative.

Table 3-101
Estimated Tax Revenue Change under the No Action Alternative

Shortage Amount (1,000 af)	Non-Indian Agriculture – Arizona ($)	Non-Indian Agriculture – California ($)	Indian Agriculture ($)
200	10,465,107	0	0
533	14,395,033	0	0
617	16,646,755	0	2,087,855
867	16,814,136	646,886	4,579,323
917	16,814,136	808,608	4,579,323
967	16,814,136	970,329	4,579,323
1,017	16,814,136	1,132,051	4,579,323
1,100	17,211,487	1,132,051	6,404,036

Source: Agricultural model output and IMPLAN 2021 software and data
Note: Includes local, state, and federal tax revenue. Tax amounts are affected by agricultural subsidies. The agricultural sectors in IMPLAN have significant amounts of government subsidies. Because tax revenue is net of subsidies, it can be negative for a given industry in a given year, if that industry receives more subsidies from the government than it pays out in these specific taxes in that year. Due to model limitations and market uncertainties, modeling results should only be used to compare the relative magnitude of impacts that are reasonably expected to occur under the alternative.

Existing system conservation agreements would offset, to some degree, the level of economic impacts associated with reduced agricultural production. There are insufficient data, however, on the degree to which this compensation would offset the regional economic impacts in the agricultural sector, due to the loss of indirect and induced jobs and income that may not be fully compensated. For example, compensation agreement funds may not be distributed to the agricultural workers who may, therefore, still experience a loss of labor income. Similarly, funds may not be distributed to

regional retail stores, restaurants, and other businesses that would typically be beneficiaries of the induced spending of labor income.

Proposed Action

Under the Proposed Action, the range of agricultural sector losses prior to consideration of compensation would be the same as modeled under the No Action Alternative. Increased system conservation would result in a higher level of compensated conservation than under the No Action Alternative. Estimated system conservation agreements include a total of 2,312,700 af of irrigation user-associated water (see **Table 3-98**). Of this amount, additional system conservation agreements modeled in California are associated with the Bard Water District and Imperial Irrigation District in Imperial County, and the Coachella Valley Water District in Riverside County. Tribal system conservation modeled in California includes the Quechan Indian Tribe in Imperial County.

In Arizona, system conservation agreements modeled with Tribal entities are associated with 550,000 af of water allocation for Tribes in Maricopa, Pinal, and Gila Counties. Additional non-Tribal system conservation agreements include approximately 138,400 af in Mohave, Yuma, and La Paz Counties

As noted in the No Action Alternative, system conservation agreements would offset, to some degree, the level of economic impacts associated with reduced agricultural production. There are insufficient data, however, on the degree to which this compensation would offset the regional economic impacts in the agricultural sector, due to the loss of indirect and induced jobs and income that may not be fully compensated.

In addition, the Proposed Action would result in higher elevations at Lake Mead, with fewer traces at higher shortage tiers, as compared with the No Action Alternative, in 2025 and 2026. As a result, the potential to reach higher-tier shortage levels for agricultural water users (for example, those shortages as modeled at 967,000 to 1,100,000 af) would be reduced. This would, in turn, result in a decreased potential to reach higher levels of economic impacts on jobs, income, and tax revenue for the regional economy compared with those modeled under the No Action Alternative.

Cumulative Effects

The potential operational changes included in the LTEMP SEIS flow options would not result in changes to water diversion amounts, water available for agriculture, or associated economic contributions.

No cumulative effects would occur on economic contributions from agriculture due to the proposed management activities planned in the Salton Sea 10-Year Plan or the environmental assessment for the implementation of the 10-Year Plan's projects. No cumulative impacts would result as the Proposed Action is not adding additional impacts to those that are already occurring; however, these impacts might occur sooner under the Proposed Action.

Issue 2: How would changes to reservoir levels as a result of water shortages impact economic activity associated with recreation?

Summary

Under both alternatives, economic contributions from recreation in Lake Powell; Lake Mead; and other reservoirs, including Lake Havasu; river-based recreation; and adjacent land-based recreation would continue. Contributions from recreation at national wildlife refuges would also continue. Due to anticipated reservoir levels, there is the potential for reduced contributions from reservoir-based recreation due to inaccessibility of boat launches in Lakes Powell and Mead as well as navigational issues. These issues would be present under both alternatives, but slightly reduced under the Proposed Action.

For river-based recreation, activities and the associated economic contributions and nonmarket values would be supported under both alternatives due to minimum flow requirements. The net economic value for whitewater rafting and anglers as a function of river flow would be similar across both alternatives, as would impacts on recreation and the associated visitor spending in the Salton Sea region. No impact on recreation contributions associated with Lake Havasu is anticipated due to a lack of anticipated changes to reservoir levels. For national wildlife refuges, no data are available to support a change in water-based recreation levels and the associated economic contributions as a result of the Proposed Action.

No Action Alternative

Under the No Action Alternative, water levels in Lake Powell would remain below thresholds for boat launching, as discussed in **Section 3.1.4**; this would impact the visitor experience for recreational boating in the reservoir. At LMNRA and GCNRA, the No Action Alternative would make boat ramps and marina services partially or completely unavailable, limiting recreation and the associated contributions and representing costs associated with maintaining access. Concessioners have spent $6 million in the last 3 years on projects directly tied to mitigating the impacts of low Lake Powell elevations (NPS 2022e).

The degree to which water levels would result in a reduction in economic contributions would depend on the impact on total visitation and related spending; these are difficult to predict given that water-based recreation is only one source of recreation-related economic contributions. Water-based recreation does, however, represent a large portion of visitor activity. Based on the most recent GCNRA visitor survey, 46 percent of visitors to the GCNRA participated in some form of motorized boating activity (NPS 2018). Water-based recreation is likely to be affected by lake volume.

Nehr et al. (2013) found lake volume in Lake Powell to be predictor of visitation levels in the summer season. This model projected that a 100,000-af increase in Lake Powell volume over a year was associated with 5,280 additional recreational visits to Lake Powell and $374,000 in additional visitor spending in tourism-related sectors in Coconino County, Arizona. The Lake Powell volume-visitation and volume-spending models imply the average visitor to Lake Powell spends $71 in the lodging, restaurant and bar, and amusement/recreation sectors in Coconino County. This estimate is generally consistent with independent estimates of visitor spending derived from prior NPS visitor surveys (Nehr 2013). Based on correlation in Nehr 2013, it was estimated that lake elevation

reductions from 3,675 to 3,625 feet would result in a more than 25 percent reduction in visitation (Johnson et al. 2016). As discussed in **Section 3.14.2**, the importance of land-based recreation may be increasing with decreasing lake elevations, which could influence total reductions in economic contributions when water levels decrease.

For Lake Mead, a similar potential for a reduction in economic contributions associated with water-based recreation is possible; this is because all but one boat launch would be inaccessible under modeled reservoir levels under this alternative. Navigational hazards would also be present, further impacting the visitor experience and potentially the level of spending ($327 million in 2021, as detailed in the affected environment section).

The availability of camping near the lakeshore during the shoulder seasons increases revenue for gateway businesses and LMNRA since the fall and spring months are the best times of year for fishing. This effectively extends the season for visitation at LMNRA, which makes revenue streams more stable for tourist-dependent businesses over a greater part of the year. As access to the shoreline changes, campers attracted for fishing opportunities may be discouraged from visiting, thus reducing income to LMNRA and local businesses.

The loss of visitation and the associated visitor spending due to low lake levels could have significant impacts on the revenue associated with LMNRA and GCNRA, including declines in entry and camping fees, as well as impacts on concessioners due to declining visitation and commercial-use fees. If operations are no longer economically viable, some concessionaires and small businesses may no longer be able to operate. This, in turn, could result in a loss of visitor services provided by concessionaries, including, but not limited to, lodging, food and beverage facilities, fuel boat tours, and a medical clinic. A loss of these services can impact the visitor experience in opportunities available, as well as travel time and visitor safety. The economies of gateway communities could be significantly affected from a loss of direct visitor spending and the associated indirect and induced spending.

No impact on recreation's contributions associated with other reservoirs, including Lake Havasu, is anticipated due to a lack of anticipated changes to reservoir levels.

For river-based recreation, commercial recreation upstream of Lake Powell may continue at present levels under the No Action Alternative and the Proposed Action. High variability of flows has and will continue to make this section of the river less popular for commercial operation.

For whitewater rafting from Glen Canyon to Lake Mead, including GCNP, it is anticipated that minimum flow requirements for Glen Canyon Dam would result in continued commercial operations. As a result, it is anticipated that economic contributions would continue to be supported under the No Action Alternative; however, the variation in flow may impact the recreational experience and the related value that users obtain from this experience.

The net economic value supported for whitewater rafting and anglers in Glen and Grand Canyons is shown in **Table 3-102**. It should be noted that the modeling estimates are based on flow and do not account for other factors that may impact boating or anglers. For example, in terms of fishing opportunities, under the No Action Alternative there is the potential for seasonal impacts on rainbow trout from temperatures at lower lake elevations in Lake Powell (see **Section 3.14.2** for additional details). Impacts on the visitor experience and level of visitation for commercial whitewater rafting have the potential to impact the associated economic contributions, which are important for rural communities and small business in northern Arizona and southern Utah, as discussed in the affected environment section.

Table 3-102
Mean Low to High Annual Net Economic Value for River-Based Recreation in Glen and Grand Canyons (Millions of $2022)

Activity	
Whitewater rafting	24.57 to 38.37
Angling	1.30 to 1.71

Note: Use values are based on methods in Gaston et al. 2015. Mean annual high and low values are based on high and low values by month from 90 ESP traces, with values provided for a 60-month simulation period. Estimated individual whitewater trips per month (NPS 2006a) are multiplied by the net economic value per trip to obtain the aggregate net economic value for whitewater rafting. The analysis does not include reservoir use, water-based day use in Glen Canyon, and recreational rafting in the lower Grand Canyon below Diamond Creek. Net economic value is indexed to 2022 dollars using the consumer price index (US Bureau of Labor Statistics 2023). The information in the table represents estimates based on best available data and should be used for the purpose of alternative comparison only.

For national wildlife refuges, no data are available to support a change in water-based recreation levels and the associated economic contributions as a result of the No Action Alternative.

In addition to potential impacts on river and reservoir recreation, there is also the potential for impacts on recreation on the Salton Sea and the surrounding region. As noted in **Section 3.14**, Recreation, the Salton Sea's shoreline would be anticipated to continue to decrease at current rates, which would increase the potential for impacts on local air quality (see **Section 3.9**, Air Quality). Decreased air quality has been correlated with decreased visitor satisfaction and spending levels not only adjacent to the Salton Sea, but in the greater Palm Springs region (Tourism Economics 2014).

Proposed Action

As described for the No Action Alternative, under the Proposed Action, projected Lake Powell elevations would be below the critical thresholds for most boat launch facilities and safely navigating Castle Rock and Gregory Butte. This would result in lower visitor satisfaction and may impact visitation numbers and economic contributions. Recreation impacts at Lake Powell would be slightly reduced under the Proposed Action because the Proposed Action would preserve more water in Lake Powell and reduce overall variability in water surface elevations; this would result in a slight

potential for reduced impacts on recreation visitation and related spending. Similarly, the slight rebound in Lake Mead pool elevations under the Proposed Action could marginally help limit the closure or relocation of boat launch facilities at Lake Mead in year 2026, compared with the No Action Alternative. This could result in a slight decrease in the potential for related impacts on recreation visitation and spending.

Impacts on whitewater boating would be the same as those described under the No Action Alternative.

As described in **Section 3.7.2**, Issue 6, under the Proposed Action, there is the possibility that IID and CVWD could enter into additional system conservation agreements; thus, there could be reduced deliveries, resulting in potentially less inflow to the Salton Sea from irrigation drainage. Therefore, the Proposed Action could result in expedited (but not additional) lakebed exposure, compared with the No Action Alternative, due to less possible available agricultural runoff. As described in **Section 3.9**, lakebed exposure can result in air quality impacts. This could result in impacts occurring on regional recreation and the associated spending in an expedited fashion compared with the No Action Alternative.

Cumulative Effects

As discussed above, this SEIS's alternatives would result in relatively minor changes in use values and economic activity associated with reservoir and river recreation. The LTEMP SEIS flow options would have the potential for cumulative impacts on economic contributions associated with sport fisheries within the Glen Canyon Dam to Lake Mead reach of the Colorado River due to changes in the water temperature released from Glen Canyon Dam, as detailed in **Section 3.14.2**.

No cumulative effects would occur on economic activity associated with recreation due to the proposed management activities planned in the Salton Sea 10-Year Plan or the environmental assessment for the implementation of the 10-Year Plan's projects. No cumulative impacts would result as the Proposed Action is not adding additional impacts to those that are already occurring; however, these impacts might occur sooner under the Proposed Action.

Issue 3: How would water shortages impact M&I uses of water?

Summary

Under both alternatives, allocated water shortages for different elevations in Lake Mead would result in domestic (e.g., M&I) water shortages compared with 2021 use levels, the last non-shortage year in the Lower Basin. The economic impacts from domestic and industrial water shortages are unknown due to the variety of approaches the municipalities and other entitlement holders use in shortage scenarios, including supply-side actions (such as groundwater recharge, water purchase agreements, and alternative water supplies) and demand-side strategies (such as water conservation measures). One study estimated that if all Colorado water were lost for 1 year, this would result in impacts on 16 million job years and $871 billion in labor income in 2014 for the Upper and Lower Basin regions (James et al. 2014).

Under the No Action Alternative, impacts would be realized at lower shortage scenarios for Arizona entitlement holders (533,000-af scenario) and Nevada entitlement holders (200,000-af scenario)

compared with California; this is due to the modeled effects of the 2007 Interim Guidelines and 2019 DCPs. Impacts on California entitlement holders would be realized at the 867,000-af shortage scenario. At a 1.100-maf shortage scenario, maximum levels of shortage would result in domestic water shortages of 179,364 af in Arizona, 30,000 af in Nevada, and 325,500 af in California (based on California's DCP contribution).

Conservation measures applied under both alternatives would reduce the potential to reach higher levels of shortage, by increasing the potential that Lake Mead levels would remain above critical levels. **Table 3-103** shows a comparison of conservation measures by alternative for users with primarily domestic use.

Table 3-103
Comparison of Modeled Conservation for Domestic Water Users (2023–2026 af totals)

State	No Action Alternative		Proposed Action	
	System Conservation	ICS	System Conservation	ICS
Arizona	209,000	—	402,400	41,800
California	146,000	—	—	216,000
Nevada	—	65,000	—	285,000

Source: Based on Shortage Allocation Model designations for the type of use and CRMMS assumptions for modeled conservation.

Modeled shortage scenarios under the Proposed Action would be the same as those under the No Action Alternative; however, the increased level of system conservation and ICS would result in higher elevations at Lake Mead, with fewer traces at higher shortage tiers as compared with the No Action Alternative in 2025 and 2026. As a result, the potential to reach higher-tier shortage levels for domestic waters users (such as those shortages modeled at 967,000 to 1,100,000 af) would be reduced.

No Action Alternative

The driest region of the country—the Census Bureau's Mountain division, comprising Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming—is expected to grow by approximately 45 percent between 2010 and 2040 (Kearney et al. 2014). Population growth combined with precipitation decreases is leading to increasing demand for municipal water throughout the study area.

As discussed in the 2007 FEIS, shortages to the Arizona M&I sector would be addressed through the states' and each local jurisdiction's drought responses and plans. These responses include supply-side and demand-side actions. Supply-side actions may include groundwater recharge, water purchase agreements, and alternative water supplies, such as brackish water and reclaimed water. Demand-side strategies focus on implementing different stages of water conservation measures as drought progresses. Existing conservation measures at the state level are shown in **Table 3-103**.

Due to shortages triggered pursuant to the 2007 Interim Guidelines in 2022 and 2023 and contributions that were made under the DCPs and other programs in the Lower Division States,

some municipalities are already enacting drought response programs. These programs often include a combination of voluntary and enforced restrictions, depending on the anticipated shortage levels (see, for example, Gilbert, Arizona's Supply Reduction Management Plan 2022). **Table 3-104**, below, shows estimated shortages for domestic use.

In 2024, Arizona M&I shortages would range from approximately 89,525 af during a 533,000-af shortage to 179,364 af during a 1.100-maf shortage (see **Table 3-104**).

Table 3-104
No Action Alternative—Impacts on Arizona Domestic Water Shortages from the Range of Analyzed Volumes of Total Shortages (af)

County	200,000	533,000	617,000	867,000	917,000	967,000	1,017,000	1,100,000
Coconino County	0	0	0	0	0	0	0	0
Gila County	0	0	0	156	156	156	156	390
La Paz County	0	0	0	0	0	0	0	1
Maricopa County	0	78,174	85,482	104,683	104,683	104,683	104,683	134,332
Mohave County	0	0	0	0	0	0	0	3,314
Pima County	0	7,317	7,317	17,986	17,986	17,986	17,986	34,031
Pinal County	0	4,034	4,034	5,337	5,337	5,337	5,337	7,296
Yuma County	0	0	0	0	0	0	0	0
Arizona Domestic Shortages	**0**	**89,525**	**96,833**	**128,162**	**128,162**	**128,162**	**128,162**	**179,364**

An estimated 146,600 af of system conservation measures for domestic uses are associated with existing signed agreements with CAP subcontractors. These may be fulfilled in part by implementing statewide and local demand-side and supply-side strategies, although conservation agreements do not dictate the specifics of how conservation is achieved.

In California, deliveries to MWD are not anticipated to be adversely affected for Lower Basin shortages until 867,000 af under the No Action Alternative; these reductions are associated with California's contributions under the DCPs, which are made notwithstanding the Lower Basin priority system, as modeled in the 2007 FEIS. For the purpose of this analysis, these reductions are assumed to result in reduced water availability to MWD, although Reclamation acknowledges that flexibility exists for how the DCP contributions may be made.

Table 3-105 shows the estimated shortages for domestic use. However, total shortage amounts would be higher than those in Arizona for the higher range of analyzed shortage amounts. The Colorado River supplies approximately 25 percent of MWD water. Drought plans are under development and include storage systems, including groundwater and surface water reservoirs, reverse flow to enhance flexibility of delivery systems, partnership agreements for additional water supply, and in-region programs with member agencies to provide cost-offset opportunities and additional flexibility (MWD 2023). No system conservation measures are in place for domestic users in California under the No Action Alternative. ICS includes 209,000 af associated with the MWD.

Table 3-105
No Action Alternative—Impacts on California Domestic Water Shortages from the Range of Analyzed Volumes of Total Shortages (af)

State	200,000	533,000	617,000	867,000	917,000	967,000	1,017,000	1,100,000
California Domestic Shortages[1]	0	0	0	186,000	232,500	279,000	325,500	325,500

[1] Includes the combined area of Los Angeles, Orange, San Diego, Riverside, and San Bernardino Counties supplied by the MWD

In Nevada, shortages to the M&I sector would mostly be borne by the SNWA, which has prepared a water resources plan (SNWA 2023) and adaptive management techniques to address water shortages. Estimated shortages for domestic use are shown below in **Table 3-106**.

Management includes voluntary and involuntary conservation programs as well as water banking. This includes ICS for domestic uses in Clark County at a level of 65,000 af.

Table 3-106
No Action Alternative—Impacts on Nevada Domestic Water Shortages from the Range of Analyzed Volumes of Total Shortages (af)

Nevada Domestic Shortages	8,000	21,000	25,000	27,000	27,000	27,000	27,000	30,000
State	**200,000**	**533,000**	**617,000**	**867,000**	**917,000**	**967,000**	**1,017,000**	**1,100,000**

In the long term, if the current guidelines under the No Action Alternative remain in effect, the water levels would be expected to decline below a critical level in Lake Mead; if water levels decline below this threshold, more severe domestic shortages would be triggered with the potential for additional social and economic impacts.

Proposed Action

Under the Proposed Action, modeled shortages would be the same as outlined in the No Action Alternative. Under this alternative, however, additional system conservation would be applied. **Table 3-103** provides an overview of the additional SEIS system conservation for domestic water users under the Proposed Action, based on Shortage Allocation Model assumptions regarding the primary type of water usage by each entitlement holder. It should be noted that these values of additional SEIS system conservation are based on modeling assumptions; they do not represent mandatory system conservation, and they in no way commit specific water entitlement holders to system conservation.

As shown in **Figure 3-20**, Percent of Traces with Lower Division Shortage and DCP Tiers, due to system conservation measures, the Proposed Action would result in higher elevations at Lake Mead with fewer traces at higher shortage tiers, as compared with the No Action Alternative, in 2025 and

2026. As a result, the potential to reach higher-tier shortage levels for domestic water users (such as those shortages as modeled at 967,000 to 1,100,000 af) would be reduced.

Cumulative Effects
The potential operational changes included in the LTEMP SEIS flow options would not impact water shortage amounts for M&I uses or the associated economic contributions.

No cumulative effects would occur on M&I uses of water due to the proposed management activities planned in the Salton Sea 10-Year Plan or the environmental assessment for the implementation of the 10-Year Plan's projects. No cumulative impacts would result as the Proposed Action is not adding additional impacts to those that are already occurring; however, these impacts might occur sooner under the Proposed Action.

3.17 Environmental Justice

3.17.1 Affected Environment

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (59 *Federal Register* 7629, February 11, 1994; US President 1994b), formally requires federal agencies to incorporate environmental justice as part of their missions. Specifically, it directs them to address, as appropriate, any disproportionately high and adverse human health or environmental effects of their actions, programs, or policies on minority and low-income populations.

Analysis consists of two steps: (1) screening of populations within the study area to identify the presence of communities for further environmental justice consideration, and (2) review of impacts to determine the potential for disproportionate adverse impacts on these communities.

As in the 2007 FEIS, the environmental justice study area is defined by those counties that may be affected by management direction that could result in water shortages or changes to water-based recreation.

While the California, Nevada, and Utah study areas are the same as those described in the 2007 FEIS and detailed in the Socioeconomic section, the Arizona study area for this SEIS has been expanded to include four additional counties: Apache, Gila, Graham, and Navajo. This is because as of 2023, there are Indian water rights settlements involving CAP water and/or non-CAP Colorado River water delivered through the CAP with several Tribes, including White Mountain Apache, which overlaps the aforementioned counties (more information is provided in subsequent paragraphs). The Arizona study area from the 2007 FEIS consisted of Coconino, La Paz, Maricopa, Mohave, Pima, Pinal, Yuma, and Yavapai Counties. The Arizona study area for this SEIS includes 12 counties. Information is provided below on locations within these counties that receive water deliveries and the rationale for the expansion of the study area.

As of 2023, there are Indian water rights settlements involving CAP water and/or non-CAP Colorado River water delivered through the CAP with the Ak-Chin Indian Community, Fort McDowell Yavapai Nation, Gila River Indian Community (GRIC), San Carlos Apache Tribe, Salt

River Pima-Maricopa Indian Community, Tohono O'odham Nation, Yavapai-Prescott Indian Tribe, Hualapai Tribe, and White Mountain Apache Tribe. Other Tribes hold CAP contracts (Pascua Yaqui Tribe, Sif Oidak District of the Tohono O'odham Nation, Tonto Apache Tribe, and Yavapai-Apache Tribe). CAP water is also retained for a future water rights settlement agreement approved by an act of Congress that settles the Navajo Nation's claims to water in Arizona. Additional details are included in **Section 3.18**, Indian Trust Assets (ITAs).

The California study area for this SEIS consists of six counties, including Riverside and Imperial Counties, where the Salton Sea is located.

Map 3-2 provides an overview of the environmental justice study area and population centers within it. **Map 3-2** also displays the environmental justice study area counties in relation to the two major storage reservoirs (Lake Powell and Lake Mead) with major fluctuations in the water's surface level.

While not shown in this map, several other mainstream dams are present. While this analysis presents data and identifies environmental justice communities at the county level, it should be noted that additional environmental justice communities may be present at a smaller geographic scale.

Each county was screened to identify the presence of low-income, minority, and Native American populations that would meet the criteria for identification as populations for further consideration for environmental justice concerns.

This section identifies environmental justice communities in the analysis area based on the following criteria:

- CEQ 1997 guidance states that minority or low-income populations should be identified where either (1) the minority or low-income population of the affected area exceeds 50 percent, or (2) the minority or low-income population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis. The total minority populations are defined as the total population minus those who identify as White, of non-Hispanic descent. For the meaningfully greater analysis, Reclamation used 110 percent of the minority percentage of the geographic reference area as the threshold for meaningfully greater. For Arizona, California, Nevada, and Utah, 110 percent of the total minority population is 51.3 percent, 70.6 percent, 58.1 percent, and 25.0 percent, respectively.
- Low-income populations are defined relative to the annual statistical poverty thresholds from the US Census Bureau (CEQ 1997). The guidance does not provide criteria for determining low-income populations as specifically as it does for minority populations. Therefore, for this analysis, low-income populations are defined as people whose income is less than or equal to twice (200 percent of) the federal poverty level. For this analysis, populations are considered low-income populations when (1) 50 percent of the population is classified as low income, or (2) any geographic area of analysis has a low-income percentage of the population equal to or higher than the reference area.

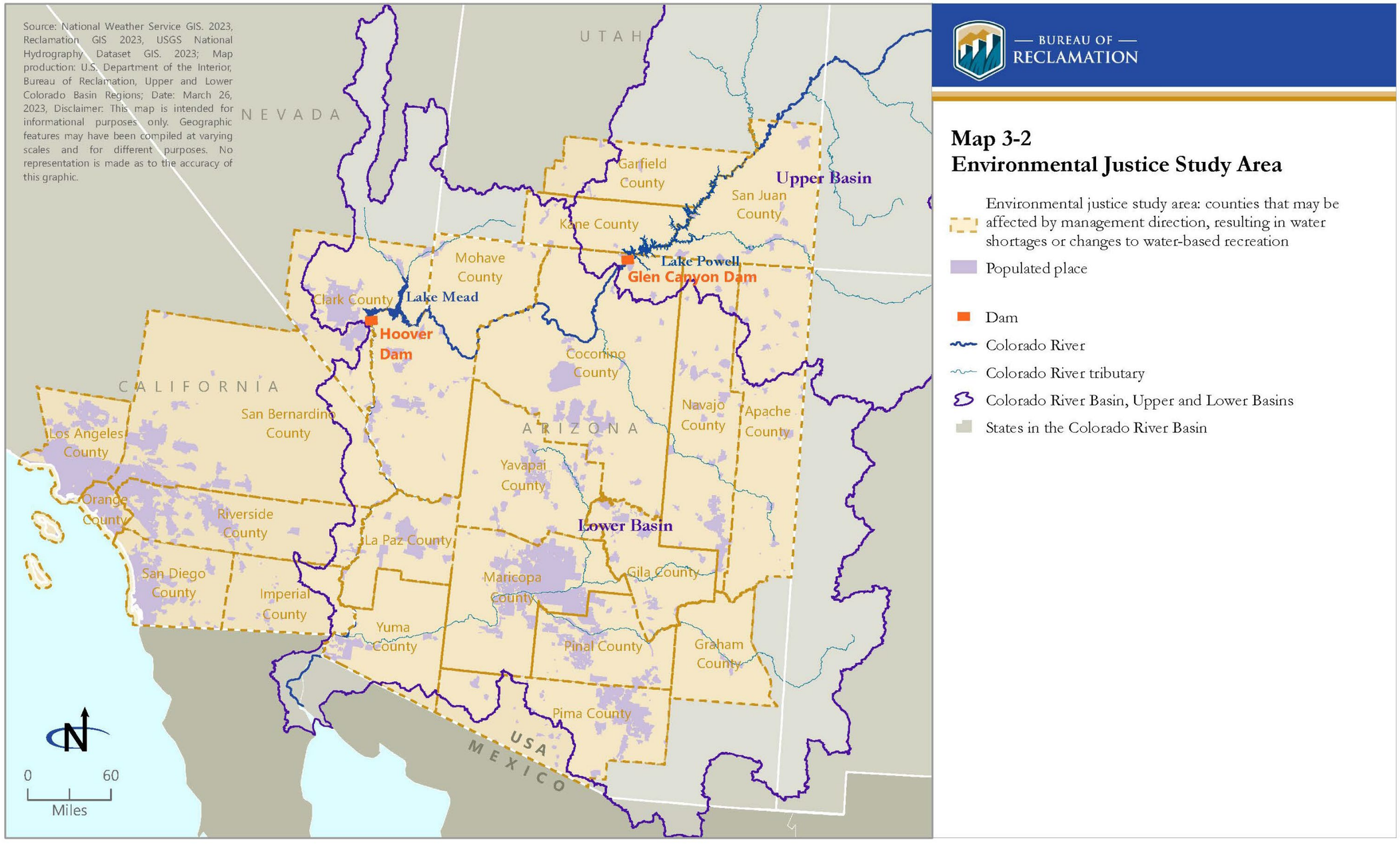
- Federally recognized Tribes are considered environmental justice populations in and of themselves; when possible, they are included in the analysis as separate minority populations. For this analysis, additional screening was utilized to review US Census Bureau data for those who identify as American Indian or Alaska Native alone or in combination with one or more other races. Reclamation also used a threshold analysis and meaningfully greater analysis to identify Indigenous populations that meet the criteria for environmental justice consideration. For this analysis, populations are considered to meet the criteria for environmental justice consideration when (1) 50 percent of the population is indigenous, or (2) any geographic area of analysis has an indigenous population percentage of the population equal to or higher than the reference area. **Table 3-107** provides an overview of the environmental justice screening results for the study area.

Overall, 19 of the 22 study area counties met at least one environmental justice criterion (11 Arizona counties, 1 Nevada county, 3 Utah counties, and 4 California counties). As such, the study area has 19 environmental justice populations at the county level. In Arizona, Apache and Navajo Counties had minority, low-income, and Indigenous populations that met the criteria. San Bernadino County, California, and San Juan County, Utah, also had minority, low-income, and Indigenous populations that met the criteria. See **Table 3-107** for more information; details for each indicator are provided below.

Additional information is also provided below on Tribal populations with the potential to be affected by the proposed management.

Further, of the 12 Arizona study area counties that each contain communities that receive Colorado River water, either through CAP or mainstream diversions, 11 counties are identified as environmental justice communities, based on the criteria described above. The only exception is Maricopa County, which did not have minority, low-income, or Indigenous populations that exceeded the respective thresholds. While Maricopa County did not have an Indigenous or minority population that met the criteria, it is important to note that both the Salt River Pima-Maricopa Indian Community and the Fort McDowell Yavapai Nation, and portions of the GRIC and Tohono O'odham Nation, are within Maricopa County.

Map 3-2
Environmental Justice Study Area



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Table 3-107
Study Area Environmental Justice Screening Results (2021)

Geographic Area	Minority Population Percentage of Geographic Area (Meaningfully Greater Percentage)	Indigenous Population Percentage of Geographic Area	Low-income Population Percentage of Geographic Area	Meets Criteria for Environmental Justice Communities of Concern?
Reference Area				
Arizona	46.6 (51.3)	5.8	31.7	—
California	64.2 (70.6)	2.3	28.5	—
Nevada	52.8 (58.1)	2.5	31.2	—
Utah	22.7 (25.0)	2.0	24.7	—
Apache County, Arizona	82.3*	75.0*	59.3*	Yes
Coconino County, Arizona	47.0	28.7*	37.4*	Yes
Gila County, Arizona	38.9	19.6*	40.9*	Yes
Graham County, Arizona	49.6	14.6*	42.3*	Yes
La Paz County, Arizona	43.9	18.4*	44.3*	Yes
Maricopa County, Arizona	46.2	3.2	28.6	No
Mohave County, Arizona	24.1	3.6	38.3*	Yes
Navajo County, Arizona	58.7*	46.3*	49.9*	Yes
Pima County, Arizona	49.6	6.1*	34.4*	Yes
Pinal County, Arizona	44.6	6.5*	31.3	Yes
Yavapai County, Arizona	20.6	3.2	32.0*	Yes
Yuma County, Arizona	70.2*	2.8	44.0*	Yes
Imperial County, California	90.3*	2.3	46.6*	Yes
Los Angeles County, California	74.5*	2.1	32.2*	Yes
Orange County, California	61.0*	1.5	23.3	No
Riverside County, California	66.8*	2.2	30.4*	Yes
San Bernardino County, California	73.4*	2.6*	34.4*	Yes
San Diego County, California	55.9*	2.0	25.2	No
Clark County, Nevada	59.4*	2.0	32.5*	Yes
Garfield County, Utah	11.9	4.6*	40.2*	Yes
Kane County, Utah	9.9	5.1*	31.5*	Yes
San Juan County, Utah	56.6*	49.8*	44.1*	Yes

*Meets the criteria for environmental justice community of concern
Source: US Census Bureau 2021a, 2021b, 2021c

Minority Population

In Arizona, 3 of the 11 counties had total minority populations that exceeded the meaningfully greater threshold of 51.3 percent. In addition, Apache, Navajo, and Yuma Counties had total minority populations well above 50 percent, ranging from 58.7 percent to 82.3 percent. The total minority population in Clark County, Nevada, exceeded the meaningfully greater threshold of 59.4 percent and is considered an environmental justice community. In California, all counties, excluding

Orange and San Diego Counties, had minority populations that met the meaningfully greater threshold of 70.6 percent. However, all counties in California had minority populations exceeding 50 percent, ranging from 55.9 percent to 90.3 percent. In Utah, San Juan County had minority population that exceeded the meaningfully greater threshold of 25.0 percent. As such, San Juan County, Utah, is identified as an environmental justice community. **Map 3-3** displays the minority populations at the county level.

Indigenous Population

In Arizona, all counties, excluding Maricopa, Mohave, and Yavapai Counties, had Indigenous populations exceeding the state average Indigenous population (5.8 percent). In California, only San Bernadino County had an Indigenous population exceeding the state average (2.3 percent). No counties in Nevada had an Indigenous population that exceeded the state average (2.5 percent). In Utah, all three counties had Indigenous populations that exceeded the state average (2.0 percent), and the Indigenous population in San Juan County, Utah, was notably higher than the other study area counties. **Map 3-4** displays the Indigenous populations at the county level.

It should be noted that the information above pertains to those counties that met or exceeded thresholds for total Indigenous population. Additional Tribal populations at the Tribe and reservation levels are identified in the *Tribal Populations* section below.

Low-Income Population

For Arizona, all study area counties, excluding Maricopa County (28.6 percent) and Pinal County (31.3 percent), had low-income populations exceeding the state average (31.7 percent). For California, all study area counties, excluding Orange County (23.3 percent) and San Diego County (25.3 percent), had low-income populations that exceeded the state average (28.5 percent). All three study area counties in Utah and the single study area county in Nevada had low-income populations that exceeded the state averages (24.7 percent and 31.2 percent, respectively). **Map 3-5** displays low-income populations at the county level.

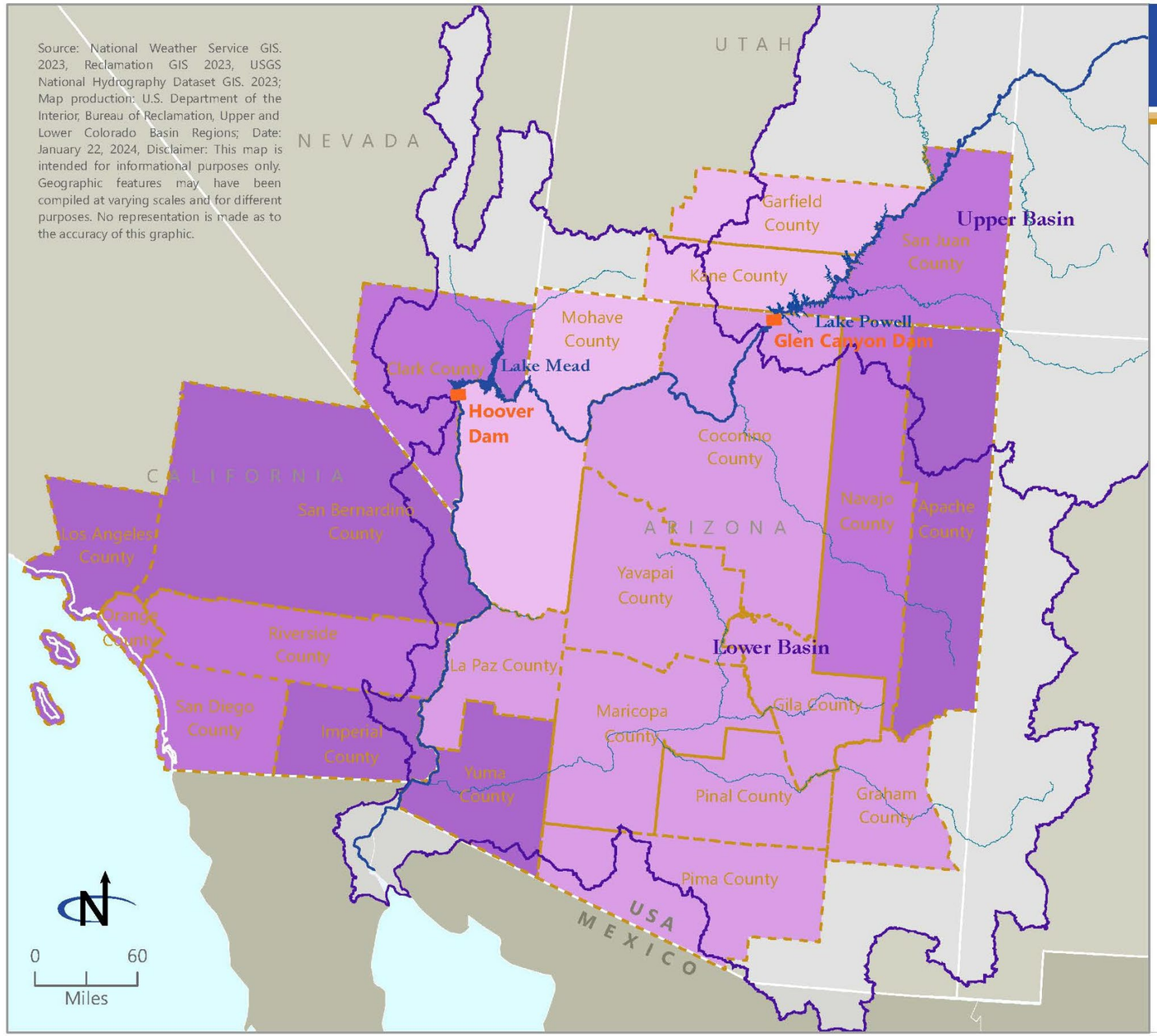
Tribal Populations

Tribal populations with potential to be affected by project management include those with current entitlements to receive Colorado River water in the Lower Basin (**Map 3-6**). The following Tribes were identified:

Tribes with entitlements related to CAP water:

- Ak-Chin Indian Community
- Fort McDowell Yavapai Nation
- Gila River Indian Community
- Pascua Yaqui Tribe
- Salt River Pima-Maricopa Indian Community
- San Carlos Apache Tribe
- Tohono O'odham Nation
- Tonto Apache Tribe

Map 3-3
Minority Populations for Environmental Justice Consideration



— BUREAU OF —
RECLAMATION

Map 3-3
Minority Populations for Environmental Justice Consideration

Percent of the population identifying as a racial and/or ethnic minority at the county level

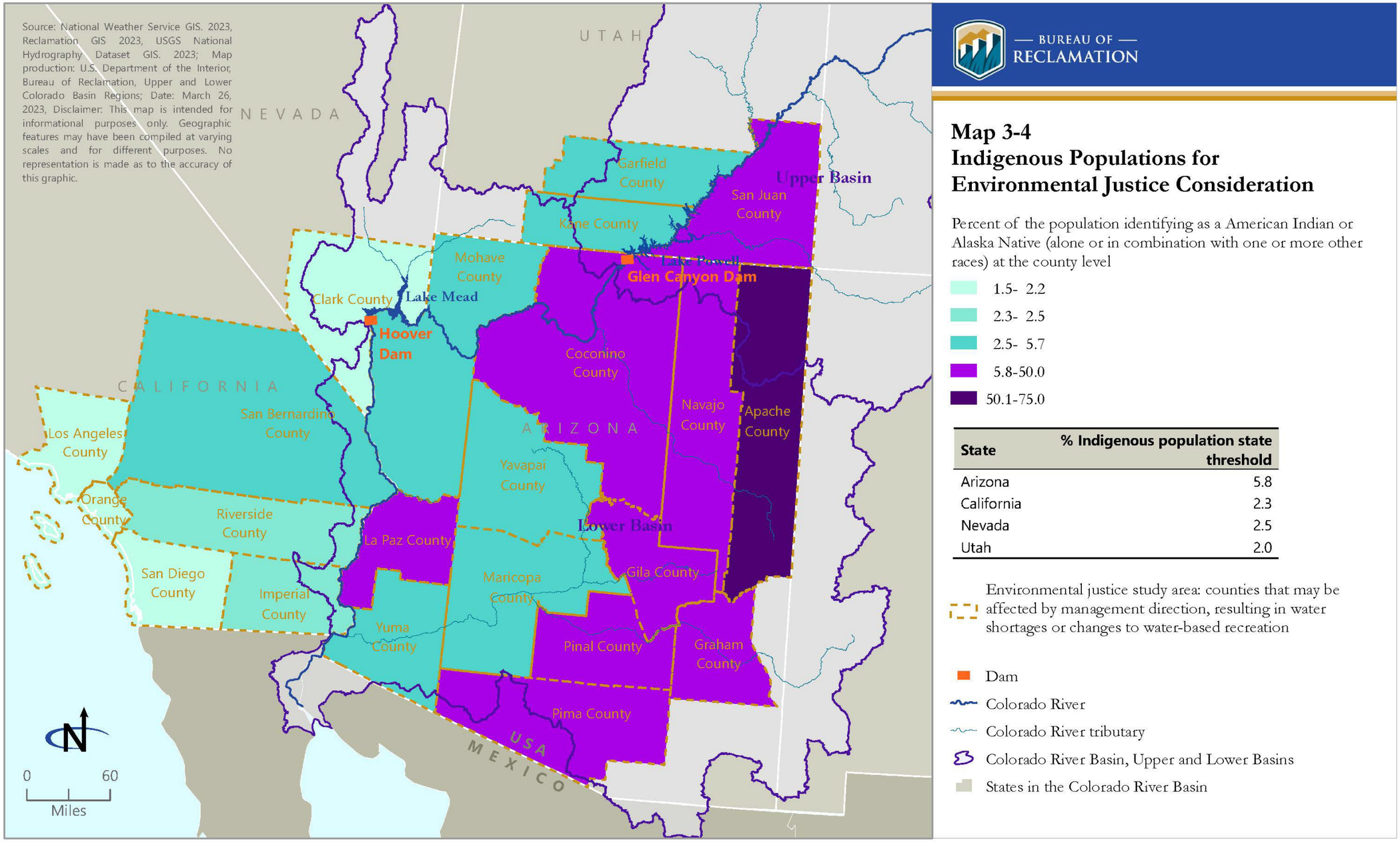
- 9.0-24.9
- 25.0-50.0
- 50.1-70.0
- 70.1-90.3

State	% minority population meaningfully greater threshold
Arizona	51.3
California	70.6
Nevada	58.1
Utah	25.0

Environmental justice study area: counties that may be affected by management direction, resulting in water shortages or changes to water-based recreation

- Dam
- Colorado River
- Colorado River tributary
- Colorado River Basin, Upper and Lower Basins
- States in the Colorado River Basin

Map 3-4
Indigenous Populations for Environmental Justice Consideration



— BUREAU OF —
RECLAMATION

Map 3-4
Indigenous Populations for Environmental Justice Consideration

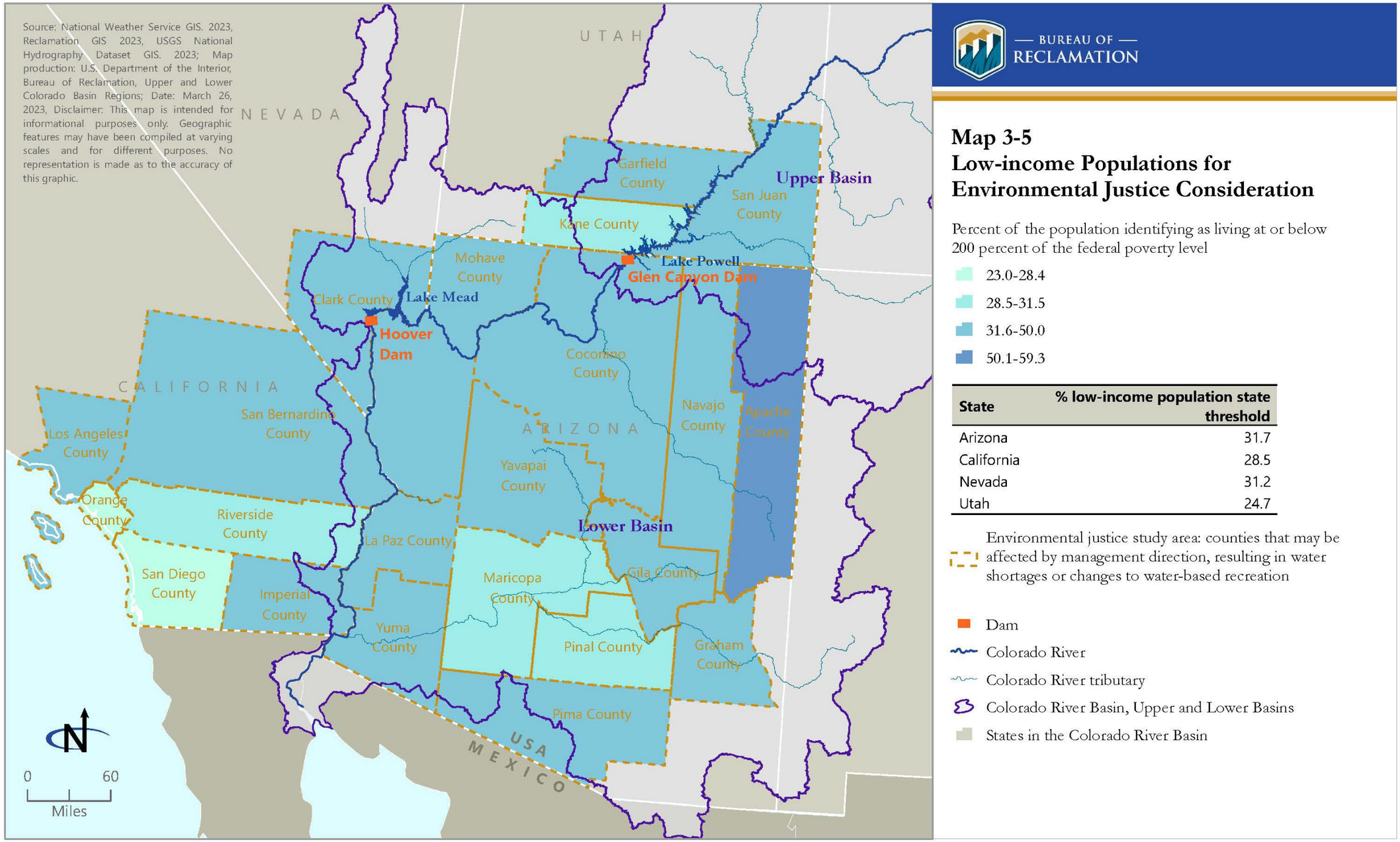
Percent of the population identifying as a American Indian or Alaska Native (alone or in combination with one or more other races) at the county level

- 1.5- 2.2
- 2.3- 2.5
- 2.5- 5.7
- 5.8-50.0
- 50.1-75.0

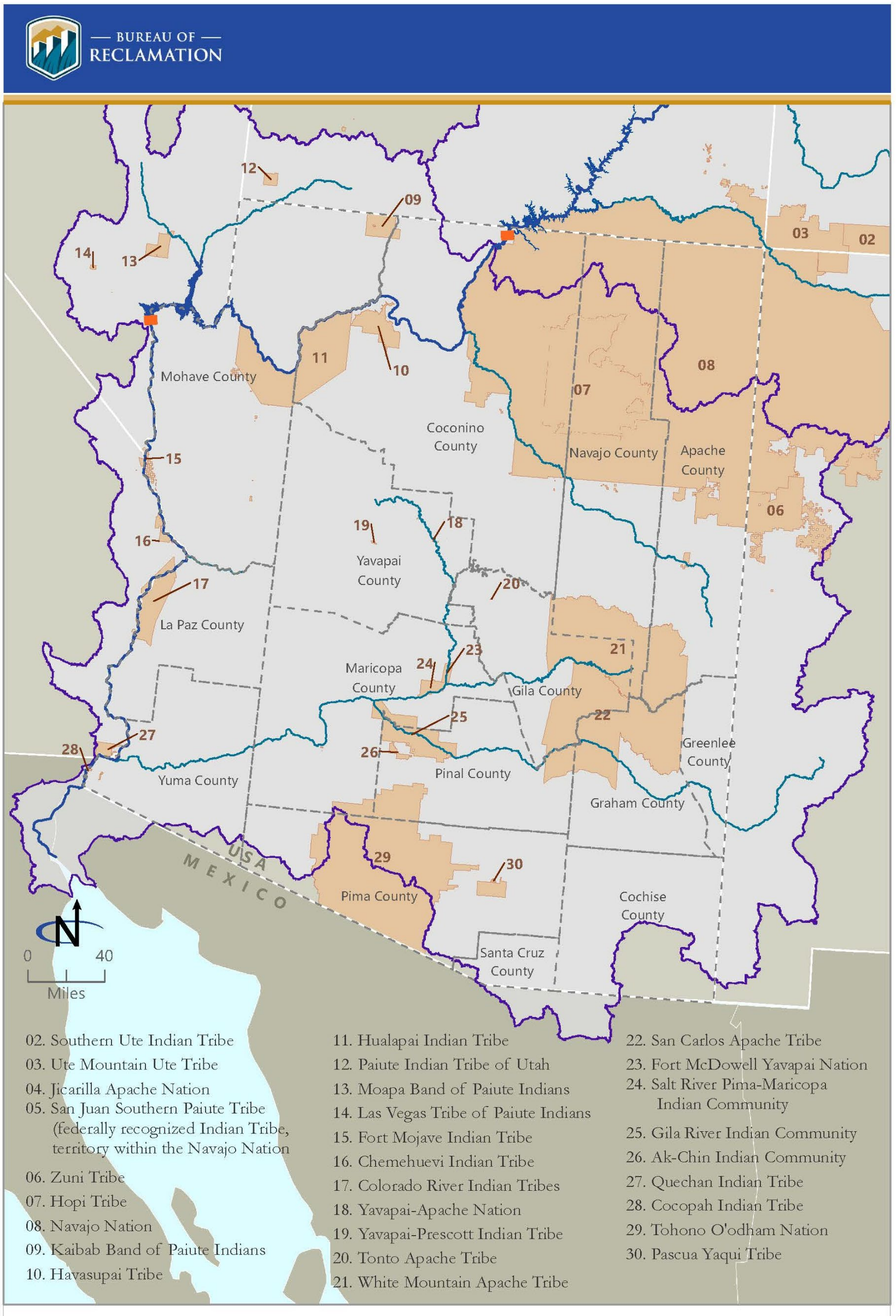
State	% Indigenous population state threshold
Arizona	5.8
California	2.3
Nevada	2.5
Utah	2.0

- Environmental justice study area: counties that may be affected by management direction, resulting in water shortages or changes to water-based recreation
- Dam
- Colorado River
- Colorado River tributary
- Colorado River Basin, Upper and Lower Basins
- States in the Colorado River Basin

Map 3-5
Low-Income Populations for Environmental Justice Consideration



Map 3-6
Tribal Populations



Map 3-6 Tribal Populations

- Tribal Reservation and off-reservation trust land
- Colorado River
- Colorado River tributary
- Dam
- Colorado River Basin, Upper and Lower Basins
- States in the Colorado River Basin

Source: National Weather Service GIS. 2023, Reclamation GIS 2023, USGS National Hydrography Dataset GIS. 2023; Map production: U.S. Department of the Interior, Bureau of Reclamation, Upper and Lower Colorado Basin Regions; Date: October 13, 2023, Disclaimer: This map is intended for informational purposes only. Geographic features may have been compiled at varying scales and for different purposes. No representation is made as to the accuracy of this graphic.

- Yavapai-Apache Nation
- White Mountain Apache Tribe

Tribes with entitlements held in the reservation's name:

- Cocopah Indian Reservation
- Fort Mojave Indian Reservation
- Fort Yuma Indian Reservation
- Colorado River Indian Reservation
- Chemehuevi Indian Reservation

In addition to the list above, the Hopi Tribe holds a contract for delivery of Colorado River water for use along the mainstream river, rather than on reservation lands.

3.17.2 Environmental Consequences

Methodology

This section relies on the analyses in other resource sections to identify whether either alternative would be likely to have adverse human health or environmental impacts. These impacts are discussed in the context of the potential for disproportionate adverse impacts on identified environmental justice communities.

This analysis also relies on modeling assumptions and modeling output from two models: CRMMS (see **Appendix D**, CRMMS Model Documentation) and the Shortage Allocation Model (see **Appendix E**, Shortage Allocation Model Documentation). While more detailed information can be found in **Appendixes D** and **E**, summary information is provided here for context.

Impact Analysis Area

The impacts analysis area is the same as that described in **Section 3.17.1**. This analysis provides baseline information for the environmental justice study area counties; however, there are communities who could experience more impacts from water shortages and changes to water deliveries. For instance, there are areas within the Arizona environmental justice study area counties in which there currently are no replacement or alternative water sources. Should these areas experience water shortages that result in available Colorado River water deliveries being reduced to zero, impacts would be more severe compared with areas where replacement or alternative water sources exist.

Assumptions

The Shortage Allocation Model does not account for replacement or alternative water sources. Refer to **Appendix E** for more information on the Shortage Allocation Model assumptions.

The modeled SEIS conservation assumptions are used to conduct CRMMS modeling. These assumptions are provided in **Section 3.7**, **Issue 6**, and **Appendix D**.

Impact Indicators

- Disproportionate and adverse human health or environmental impacts
- Shortage levels at which available water would be reduced to zero for priorities/users within environmental justice study area counties
- Percentage of traces with Lower Division shortage and DCP tiers

Issue 1: How would management decisions affect environmental justice communities?

Summary

Under the No Action Alternative, no modeled shortage levels resulted in available water being reduced to zero under any priorities for California and Nevada. However, if shortages reached 533,000 af, available water would be reduced to zero for certain entitlements within the CAP in Arizona's fourth priority, extending to additional entitlements at a shortage of 617,000 af. Arizona fifth and sixth priorities are assumed not to be available in any level of shortage. Some users in Maricopa, Pinal, and Pima Counties would have their CAP water supply reduced to zero.

It should be noted that shortage levels modeled for the No Action Alternative would be the same as those for the Proposed Action in the short term. However, projections based on low-flow hydrologic scenarios indicate that, without a change to current operational guidelines, decreasing reservoir levels would result in increased system shortages, potentially limiting the ability to deliver water. This could result in an increased level of impacts on environmental justice communities.

Under the Proposed Action, modeled shortage levels are the same as those under the No Action Alternative. As a result, available water would be reduced for the same counties in Arizona (Maricopa, Pinal, and Pima Counties, which represent the current CAP service area where CAP deliveries occur) as under the No Action Alternative. Impacts on irrigation and domestic use from water shortages would be the same as those described for the No Action Alternative. While the shortage levels at which available water would be reduced to zero would vary by state and priority, the same environmental justice study area counties would experience available water being reduced, or impacts from available water being reduced, under the Proposed Action for this time period. In the longer term, hydrologic models indicate that reservoir levels would be maintained above critical levels for a longer length of time with the implementation of the Proposed Action. Therefore, impacts on environmental justice communities could be reduced compared with the No Action Alternative in the long term.

Compared with the No Action Alternative, the Proposed Action would result in an increased level of system conservation, through the proposed SEIS system conservation. This would allow for a reduced potential for higher levels of modeled shortages and mandatory shortages to occur and would provide greater predictability for water users. For example, if an entity chose to enter into a system conservation agreement and voluntarily conserve Colorado River water, this would contribute to maintaining water levels in the system overall. It also would reduce the potential that mandatory shortages would be triggered in lower operational years. As a result, the Proposed Action would reduce the likelihood of the impacts on individual users from higher modeled shortage amounts, including those within environmental justice counties.

No Action Alternative

Existing system conservation and ICS were modeled using CRMMS. Under the No Action Alternative, total modeled system conservation is estimated to be 938,758 af. Detailed assumptions are provided in **Appendix D**. System conservation is Colorado River water conserved through agreements with individual users who are compensated. In contrast, ICS is not compensated. Under the No Action Alternative, existing modeled system conservation includes executed agreements with the following entities in Maricopa, Pinal, Pima, Mohave, Yuma, and La Paz Counties, Arizona: GRIC, Fort McDowell Yavapai Nation, CAWCD and certain CAP subcontractors, Mohave Valley Irrigation and Drainage District, Yuma Mesa Irrigation and Drainage District, and Gabrych Farms. Additionally, modeled system conservation includes an executed agreement with Palo Verde Irrigation District in Riverside and Imperial Counties, California.

Under the No Action Alternative, a range of volumes of total shortage to Lower Division States were analyzed using a Shortage Allocation Model. Potential water shortages would not impact water deliveries in California or Nevada to the degree that there would be zero water for any priorities under the No Action Alternative, as detailed in **Section 3.7**, Water Deliveries.

Eleven of the Arizona counties are environmental justice communities. Two of the three counties comprising the CAP service area are environmental justice communities (Pinal and Pima). Given the assumption that Arizona fifth and sixth priorities are assumed not to be available in any level of shortage, a Lower Basin shortage would cause the reduction of water deliveries first to the Arizona fourth-priority Colorado River entitlements, which include CAP Arizona fourth-priority (P4[ii]) and other post-1968 Arizona fourth-priority Colorado River contractors (P4[i]).

Under the No Action Alternative, there are shortage levels where available water for users under some priorities would be reduced to zero in Arizona. According to the model results, at water shortage levels ranging from 533,000 af to 1.100 maf, some water users within the Arizona environmental justice study area counties would be reduced to zero water availability under certain priorities of Colorado River water. These impacts are discussed in further detail below. The degree to which these shortages would result in disproportionate adverse impacts would depend on the availability and cost of alternative water supplies.

Irrigation

At shortage levels of 533,000 af and greater, available water for users under the Arizona fifth- (unused entitlement/apportionment) and sixth- (surplus) priority entitlements, and users of the CAP excess pool in Maricopa, Pinal, and Pima Counties, Arizona, would be reduced to zero.

Pinal and Pima Counties are identified as environmental justice communities. As such, the water users within these counties who would have water delivery reduced to zero would face disproportionate consumptive-use impacts on irrigation. Farmers who have used CAP excess water to irrigate crops would need to use alternative water supplies, such as groundwater, if available, to continue agricultural production.

The Salton Sea receives flows from excess irrigation drainage, particularly from the IID and CVWD, which are in Riverside and Imperial Counties, California. These two counties are considered

environmental justice counties. Under the No Action Alternative, there would be no changes to current operational activities that would affect flows to the IID or CVWD. Therefore, the surface water elevation of the Salton Sea could continue to decrease at the current rate. Surface water elevation decreases could impact all communities adjacent to the Salton Sea, including environmental justice communities.

Domestic Use

Consumptive-use impacts on domestic uses would vary by the volume of total shortage to the Lower Division States. The number of counties, different types of priority holders, and different types of entitlement holders who would face zero water supply would increase as the volume of total shortage to Lower Division States increased (see **Appendix E**).

At levels of shortage of 533,000 af and greater, domestic water supply from the CAP NIA-B[25] priority in Maricopa, Pinal, and Pima Counties would not be available. If water shortages reached 617,000 af, available water for users under the CAP NIA-A priority would also be reduced to zero.

Tribal Allocations

The allocations discussed in this section are based on the Shortage Allocation Model, which is more detailed and specific than the regional analysis presented in **Section 3.7.2**, **Issue 6** (see also **Appendix E**).

Under the No Action Alternative, available water for all users under CAP NIA-A priority in Maricopa, Pima, and Pinal Counties will be reduced to zero if water shortages reach 617,000 af. The Tohono O'odham Nation and GRIC hold CAP NIA allocations in this pool that would be reduced to zero. Beyond the CAP NIA pool, at higher levels of modeled shortage, the available water supply for Tribes holding other entitlements to Arizona fourth-priority water (P4[i] or P4[ii]) are projected to be reduced. At the allocation level, this impacts six Tribal entitlements in Arizona (Hopi Tribe, GRIC, Ak-Chin Indian Community, San Carlos Apache Tribe, Salt River Pima-Maricopa Indian Community, and Tohono O'odham Nation [Schuk Toak and San Xavier Districts]); however, the Shortage Allocation Model does not account for the existence of external arrangements and commitments that would affect alternate water availability to these Tribes or the ultimate impacts of water unavailability to the entitlement (see **Appendix E**). However, even if water deliveries are reduced to Tribes during shortages, the entitlement to the underlying water rights would not be affected.

Proposed Action

As with the No Action Alternative, existing system conservation and ICS were modeled using CRMMS. However, the modeling assumptions for the Proposed Action also include additional SEIS conservation for operational years 2023 through 2026.

Under the Proposed Action, total modeled system conservation (including system conservation and ICS) is estimated to be 3,038,611 af. The modeling assumptions indicate an anticipated increased

[25] NIA refers to the CAP Non-Indian Agricultural Priority subcontracts. The NIA-A and NIA-B designations approximate the shortage sharing provisions in applicable contracts and subcontracts, including paragraph 4.7(b)–(c) of the NIA subcontracts.

level of system conservation, compared with the No Action Alternative. Under the Proposed Action, additional entities in California and Arizona would participate in system conservation, with a total of nine entities in Arizona and five entities in California.

In addition to the existing system conservation being carried out by the entities described under the No Action Alternative, the San Carlos Apache Tribe, Colorado River Indian Tribes, and Welton-Mohawk Irrigation and Drainage District are assumed to participate in system conservation under the Proposed Action in Arizona. In California, additional system conservation would be carried out by two water districts (Coachella Valley Water District and Bard Water District), one irrigation district (Imperial Irrigation District), and one Tribe (Quechan Indian Tribe).

Further, the CRMMS modeling output demonstrates a reduced potential for higher shortage volumes to occur. Part of CRMMS modeling involves generating multiple time series, or "traces," of forecasted streamflow. The percentage of traces below critical elevations at Lake Powell and Lake Mead help us understand how changes to operational activities would affect reservoir elevations. Reservoir elevations are one metric that help characterize impacts on hydrologic resources and thereby characterize potential impacts on communities, including environmental justice communities who rely on such resources. As described in **Section 3.7.2**, the Proposed Action would result in higher elevations at Lake Mead, with fewer traces at higher shortage tiers, as compared with the No Action Alternative, in 2025 and 2026 (see **Figure 3-20**). In other words, the Proposed Action would reduce the potential for mandatory shortages to occur based on Lake Mead elevations.

The Shortage Allocation Model does not have a version unique to the Proposed Action since the distribution and priority of shortages are the same as under the No Action Alternative. However, the Shortage Allocation Model results provide for a meaningful comparison of alternatives, as they help to characterize existing conditions and thereby assess how the Proposed Action and associated proposed system conservations would impact overall water supply to specific water entitlement holders.

Hydrologic Resources and Water Deliveries

Irrigation

Under both alternatives, at higher levels of modeled shortage, available water would be reduced to zero for Arizona 5th- and 6th-priority contracts and CAP agricultural and other excess water users (see **Appendix E**). Under the Proposed Action, if higher levels of modeled shortage occurred, the irrigation impacts would be the same as those described under the No Action Alternative. However, under the Proposed Action modeled system conservation is estimated to be higher (compared with the No Action Alternative), as three additional California irrigation users (CVWD, BWD, and IID) and one Arizona irrigation user (Wellton-Mohawk Irrigation and Drainage District) would voluntarily conserve based on modeled assumptions. The additional system conservation proposed under the Proposed Action would contribute to a reduced potential for higher levels of modeled shortage to occur.

By avoiding higher levels of modeled shortage through increased system conservation, available water supply for irrigation use would be maintained in a manner that would reduce irrigation impacts for all entities who rely on the Lower Basin water supply for irrigation use, including those

located in environmental justice counties in Arizona (La Paz, Mohave, and Yuma Counties) and California (Imperial and Riverside Counties).

While system conservation would result in some users located within environmental justice counties voluntarily reducing use of available water supply for irrigation, the voluntary nature of such reductions could reduce the severity of impacts on irrigation as compared with those resulting from mandatory reductions. For instance, irrigation users may have greater capacity to plan for and adjust to reduced water supply. This includes irrigation users who would face irrigation impacts at higher levels of modeled shortage.

The irrigation districts, irrigation and drainage districts, and water districts participating in system conservation in Arizona and California would be compensated under these system conservation agreements. As described in **Section 3.16**, a higher level of compensated conservation would offset to some degree the economic impacts associated with reduced agricultural production. However, the ultimate distribution of compensatory funds within the economy is unknown. There is insufficient data to determine the economic impacts of compensation on the agricultural sector due to the loss of indirect and induced jobs and income that may not be fully compensated. For example, compensated conservation funds may not be distributed from the entitlement holder to the agricultural workers, who may therefore still experience a loss of labor income. Similarly, funds may not be distributed to regional retail stores, restaurants, and other businesses that would typically be beneficiaries of the induced spending of labor income. While the water entitlement holder would be compensated, end point impacts would depend on compensation distribution. This is true for all water user groups (irrigation, domestic, and Tribal) who participate in system conservation.

As described in **Section 3.7.2**, Issue 6, under the Proposed Action there is the possibility that IID and CVWD could enter into additional system conservation agreements. Thus, there could be reduced deliveries, resulting in potentially less inflow to the Salton Sea from irrigation drainage. Therefore, the Proposed Action could result in expedited (but not additional) lakebed exposure compared to the No Action Alternative, due to the possibility of less available agricultural runoff. As described in **Section 3.9**, lakebed exposure can result in air quality impacts. These air quality impacts could potentially impact nearby environmental justice communities to a higher degree.

Domestic Use

Under the Proposed Action, domestic use impacts would be the same as those described under the No Action Alternative. Under both alternatives, at higher levels of modeled shortage, available water supply for domestic use would be reduced to zero for CAP NIA-A and CAP NIA-B entitlement holders (see **Appendix E**). However, the additional system conservation proposed under the Proposed Action would contribute to a reduced potential for higher levels of modeled shortage to occur. By avoiding higher levels of modeled shortage through increased system conservation, available water supply for domestic use would be maintained in a manner that would reduce consumptive-use impacts on domestic uses for all entities, including users with CAP NIA-A and NIA-B priority entitlements located in environmental justice counties.

Under the Proposed Action, there would be additional system conservation carried out by domestic users (certain CAP subcontractors) in Arizona.

Tribal Allocations

Under the Proposed Action, impacts would be the same as those described under the No Action Alternative. Modeled system conservation is estimated to be higher, however, and two additional Tribal entitlement holders in Arizona (San Carlos Apache Tribe and Colorado Indian River Tribes) and one in California (Quechan Indian Tribe) would voluntarily conserve under the Proposed Action. These entities would be compensated for system conservation. While the water entitlement holder would be compensated, end point impacts would depend on compensation distribution.

The additional system conservation proposed under the Proposed Action would contribute to a reduced potential for higher levels of modeled shortage to occur. By avoiding higher levels of modeled shortage through increased system conservation, the potential for and severity of impacts on water supply for Tribal allocations would be reduced.

Gila, La Paz, Pima, Pinal, and Yuma Counties are identified as environmental justice communities. As such, the Tribal water entitlement holders located within these counties could face temporary, disproportionate consumptive-use impacts on irrigation and domestic use. Production on Tribal lands provides an important economic base for many Tribal communities, including those in the Arizona study area (Deol and Colby 2018). A lack of water supply could result in reduced agricultural production and a loss of Tribal revenue. Further, other Tribal uses of the entitlements include domestic, municipal and industrial, stock, and like uses, and a lack of water supply could result in reduced water availability for these purposes and a loss of Tribal revenue. However, it is important to note that losses in revenue are affected by other factors, including, but not limited to, the implementation of water rights settlements and availability of other resources. The Shortage Allocation Model does not account for the existence of external arrangements and commitments that would affect alternate water availability to these Tribes or the ultimate impacts of water unavailability to the entitlement.

Studies have documented impacts associated with losses in revenue. For example, one Utah State University study, which included several Tribes in Arizona, including the Tohono O'odham Nation, found that reductions in cattle and hay production due to drought result in reduced economic activity in related sectors and significant economic losses for Tribal economies in Arizona (Drugova et al. 2020). As detailed in **Section 3.16.2**, shortage may result in the loss of production for Tribal agricultural lands for a given year. Water delivery reductions may result in the fallowing of some Indian lands, with the potential for economic impacts, as described above. However, even if water deliveries are reduced to Tribes during shortage, the entitlement to the underlying water rights would not be affected. See **Section 3.18** for further information.

Water Quality

Potential changes to water quality were evaluated for salinity, temperature, metals, and perchlorate. Effects on these parameters would be minor and would not disproportionately affect any environmental justice communities in the study area. As elevations decrease, the dilution capacity of Lake Powell and Lake Mead would also decrease but would not likely result in any significant decrease in dilution capacity or increase in concentrations of metals of concern, including for environmental justice communities. However, quantified water-quality impacts related to dilution capacity are not available; therefore, it is difficult to project the quantified water-quality impacts, and

alternatives cannot be compared (**Section 3.8**). Under any alternative, salinity would not exceed numeric salinity criteria established by the Colorado River Basin Salinity Control Forum.

Air Quality and Climate Change

As described in **Section 3.9.2**, under the Proposed Action there would potentially be more shoreline exposed at Lake Mead and Lake Powell as compared with the No Action Alternative. The increase in exposed shoreline would potentially have a negative effect on air quality.

At the Salton Sea, the current shoreline area could continue to decrease at the current rate. Under the Proposed Action, there is the possibility that IID and CVWD could take additional shortages; if so, there could be reduced river flows and thus potentially less inflow to the Salton Sea from irrigation drainage. However, both alternatives anticipate an increase in exposed shoreline, and this increase would potentially have a negative effect on air quality because the decreasing water level would increase fugitive dust. Since dust is already a concern for the Salton Sea area, additional dust would affect local air quality and public health.

The Salton Sea is located in two environmental justice counties in California: Riverside and Imperial. Under the Proposed Action, additional dust could result in disproportionate impacts on these environmental justice communities.

Under the Proposed Action, the reduction of hydropower could result in an increase in GHG emissions due to alternative power sources (see **Section 3.9**, Air Quality). When calculated, however, the potential GHG emissions from coal and natural gas alternatives are a very small percentage of the 11-state and US GHG emissions. The totality of climate change impacts is not attributable to any single action; nonetheless, this project-related emission, in combination with a variety of GHG emission sources around the world, could exacerbate climate-related impacts (albeit as a small contribution). Therefore, the Proposed Action could result in contributions to potential disproportionate effects on environmental justice communities.

Visual Resources

As described in **Section 3.10**, potential impacts on visual resources were considered (for both Lake Mead and Lake Powell) for attraction features, calcium carbonate rings, and sediment deltas, which would be viewed from adjacent highways, from the lake surface, and from trails in the area. Based on the potential higher lake elevations associated with the Proposed Action, there would be less modification to landscape character along the edge of Lake Powell and Lake Mead, including impacts on viewers, than under the No Action Alternative.

While some of these features (for example, Rainbow Bridge) are located within San Juan County, Utah, an environmental justice community, effects are not disproportionate or unique to any environmental justice community.

Also considered were potential impacts on landscape character along the Colorado River between Glen Canyon Dam and Lake Mead (associated with potentially lower flows through Grand Canyon) and impacts on landscape character associated with decreasing water deliveries/allocations in the Lower Division States (see **Section 3.10**, Visual Resources). Changes to the natural landscape character along the Colorado River between Glen Canyon Dam and Lake Mead would impact any

environmental justice communities located within these areas. Additionally, there could be impacts on the irrigated, agricultural landscapes within the Lower Division States, where the influence of the Colorado River into adjacent lands could narrow as these areas would begin transition to their natural, arid condition, resulting in changes to landscape character compared with the existing condition. These changes to visual resources would also impact environmental justice communities within or adjacent to these landscapes. However, under the Proposed Action, the different release tiers would temper impacts on landscape character with the goal of maintaining consistent flows along the Colorado River (including through the Grand Canyon) while keeping Lake Powell above 3,500 feet. The proposed SEIS conservation would temper visual impacts on environmental justice communities.

Biological Resources

Potential impacts on vegetation, wildlife, and fish due to the No Action Alternative and Proposed Action would be similar, as the alternatives vary only by system conservation measures. The Proposed Action would result in slightly reduced impacts on wildlife. In some cases, impacts on fish and vegetation would be slightly higher under the Proposed Action, due to reduced water flows. However, potential impacts on biological resources would not disproportionately impact any environmental justice community identified within the study area.

Scoping and subsequent consultation did not result in the identification of any environmental justice community for whom indigenous fish, vegetation, or wildlife constituted a significant portion of their diet. There would be no difference in rates or patterns of subsistence consumption by environmental justice communities, including Indian Tribes, in comparison to the general population in the study area. See **Section 3.13**, Biological Resources, for more detailed information.

Cultural Resources

Section 3.11.2 analyzes how changes in operations would affect TCPs and resources of concern to Native Americans. For Lake Mead, the Proposed Action would have fewer negative impacts on cultural resources due to site exposure than the No Action Alternative, as pool elevations would be slightly higher. Adverse effects on sacred sites and TCPs could disproportionately impact Tribes for whom these resources provide cultural or spiritual significance and value. However, adverse effects on TCPs would be resolved through the LTEMP PA, land management agency actions, or the NHPA Section 106 process. See **Section 3.11**, Cultural Resources, for detailed information. Overall, the additional SEIS conservation would allow for reduced potential of higher modeled shortages and would result in fewer negative impacts on cultural resources than the No Action Alternative, as pool elevations would be slightly higher.

Under the Proposed Action, if conservation measures are required and implemented, less water would be flowing into the Salton Sea; this may lead to the exposure of cultural resources in the lakebed more quickly than under the No Action Alternative, but the result will eventually be the same as under the No Action Alternative. As such, disproportionate impacts on environmental justice communities are not anticipated.

Indian Trust Assets

Reclamation has concluded that the Proposed Action would have no significant impacts on Indian Trust Assets (ITAs). Reclamation is committed to protecting and maintaining ITAs and rights reserved by or granted to Indian Tribes or individual Indians by treaties, statutes, and executive orders. See **Section 3.18**, Indian Trust Assets, for more detailed information.

Electrical Power Resources

Changes to electrical power production have the potential to affect environmental justice communities disproportionately through possible increases in electricity rates resulting from decreased electrical power generation under the Proposed Action. Decreases in electrical power generation under the Proposed Action are anticipated to be highest in 2024 and decrease over the life of the project. However, the facilities potentially affected produce less than 2 percent of the total power produced in the region. Therefore, no substantial environmental justice effects are anticipated.

A decrease in available hydropower could result in reliance on other fuel sources for electricity generation. In California, utilities increased fossil fuel generation of electricity to compensate for the drought-driven decline in hydroelectricity, increasing state carbon dioxide emissions in 2011–2012 by 1.8 million tons of carbon, the equivalent of emissions from roughly 1 million cars (USGCRP 2018). Other southwestern states also shifted some generation from hydropower to fossil fuels (USGCRP 2018). If water shortages resulted in the need to rely on other fuel sources, environmental justice communities could face disproportionate health impacts associated with carbon dioxide emissions; such impacts are well documented (CDC 2021; EPA 2017; USGCRP 2018).

Recreation

Potential recreational impacts are primarily associated with reduced reservoir elevations affecting access or necessitating capital alterations to shoreline facilities around Lake Powell and Lake Mead. Impacts on recreation are generally similar under both alternatives. Recreation impacts at Lake Powell would be slightly reduced under the Proposed Action because the Proposed Action preserves more water in Lake Powell and reduces overall variability in water surface elevations.

Individuals and businesses within San Juan County, Utah, the population of which is greater than 50 percent minority, could be affected by these recreational impacts. However, the effect would not be disproportionate to the recreational impacts experienced by other counties adjacent to Lake Powell and Lake Mead.

Socioeconomics

Under the Proposed Action, there is potential for shortages to result in economic impacts due to agricultural value changes, municipal water shortages, and changes to recreation-based economic contributions. The locations of impacts would vary by shortage level. While higher levels of modeled shortage could still occur under the Proposed Action, the higher level of system conservation would reduce the potential for higher levels of modeled shortage to occur, thereby maintaining water in the system and lessening socioeconomic impacts—including those to environmental justice communities—associated with higher levels of modeled shortage.

As described in **Section 3.16.2**, changes to reservoir levels as a result of water shortages impact economic activity associated with recreation. Due to anticipated reservoir levels, there is the potential for reduced contributions from reservoir-based recreation due to inaccessibility of boat launches in Lakes Powell and Mead as well as navigational issues. These issues would be present under both alternatives, but slightly reduced under the Proposed Action. Reduced economic contributions associated with reduced recreation could result in potential disproportionate impacts to environmental justice communities, including tribes, however the magnitude of impacts would depend on the degree to which environmental justice communities rely on revenue generated from recreation. However, potential impacts to environmental justice communities would be slightly reduced under the Proposed Action.

As described in **Section 3.12**, anticipated water shortages would result in agricultural production loss under both alternatives. Under both alternatives there would be an estimated potential of up to $116 million in agricultural revenue loss; however, these impacts would be tempered by system conservations under the Proposed Action. Potential agricultural revenue loss could result in disproportionate impacts on environmental justice communities, including Tribal populations, depending on how much Tribes rely on revenue from water deliveries. However, this analysis cannot characterize the level of magnitude of such impacts, as Tribal revenue data are not available.

Under the Proposed Action, the range of agricultural sector losses prior to consideration of compensation would be the same as modeled under the No Action Alternative. Increased system conservation would result in a higher level of compensated conservation than under the No Action Alternative (**Table 3-98**). This would offset to some degree the level of economic impacts associated with reduced agricultural production. As noted above, system conservation would be compensated under both alternatives. However, economic impacts associated with system conservation compensation, and resulting impacts on environmental justice communities, are difficult to determine. Depending on distribution of funds, there is potential for disproportionate adverse impacts on low-income and minority populations. Further, water being conserved through system conservation may no longer contribute to certain uses, resulting in potential for economic loss.

Cumulative Effects

The LTEMP SEIS flow options would not result in any changes to disproportionate adverse health or environmental impacts. Therefore, there is no expected change in impacts on environmental justice communities.

Food production, electricity generation, and human health in the Southwest are vulnerable to water shortages. In the Southwest, severe drought, wildfire, and temperatures have increased and are anticipated to continue. Trends of population growth have affected—and will continue to affect—the demand for water, agricultural products, electricity, and housing. These trends will contribute to cumulative effects. Environmental justice communities, including Native Americans, are among the most at risk from climate change, often experiencing the worst effects because of higher exposure, higher sensitivity, and lower adaptive capacity for historical, socioeconomic, and ecological reasons (CDC 2021; EPA 2017; USGCRP 2018).

No cumulative effects would occur on environmental justice communities due to the proposed management activities planned in the Salton Sea 10-Year Plan or the environmental assessment for the implementation of the 10-Year Plan's projects. No cumulative impacts would result as the Proposed Action is not adding additional impacts to those that are already occurring; however, these impacts might occur sooner under the Proposed Action.

3.18 Indian Trust Assets

3.18.1 Affected Environment

This section is summarized from Section 3.10, Indian Trust Assets (ITA), from the 2007 FEIS (Reclamation 2007) and is updated with changes since 2007. ITAs are assets held in trust by the federal government for the benefit of Native American Tribes or individuals (DOI 2023a). ITAs can be on or off reservation lands and can consist of land, water rights, mineral rights, hunting and fishing rights, grazing rights, or other assets.

Reclamation is consulting with Tribes, including those Tribes with water rights and water delivery contracts, regarding the proposed changes to the 2007 Interim Guidelines.

Analysis of the impacts on the Salton Sea are not relevant to this resource.

Water Rights and Trust Lands

Following the 2007 Interim Guidelines, water rights and trust lands include "federal reserved Indian rights to Colorado River water including rights established pursuant to *Arizona v. California*, Colorado River water Tribal delivery contracts where such contracts are part of a congressional approved water rights settlement; and Indian reservations" (Reclamation 2007). Reservations are treated as trust assets for the analysis, although they are not "technically synonymous with trust lands" (Reclamation 2007).

Water rights of the Chemehuevi Indian Tribe, Colorado River Indian Tribes, Fort Mojave Indian Tribe, Fort Yuma-Quechan Tribe, and Cocopah Indian Tribe under the 1964 *Arizona v. California* decision and the 2006 Consolidated Decree are summarized in Table 3.10-1, Colorado River Mainstream Diversion Entitlement (Water Rights) in Favor of Indian Reservations, in Section 3.10.11 of the 2007 FEIS (Reclamation 2007).

Tribal entitlements to Central Arizona Project (CAP) water and/or non-CAP Colorado River water delivered through the CAP in central Arizona are administered pursuant to water delivery contracts between Tribes and the Secretary. CAP water entitlements also may be incorporated into congressionally approved Indian water rights settlements. A summary of congressionally approved water rights settlements as of 2007 is presented in Section 3.10.1.2 of the 2007 FEIS (Reclamation 2007), and water rights involving CAP water for the CAP Tribes as of 2007 are summarized in Table 3.10-2, Central Arizona Project Indian Tribal Diversion Entitlements (Water Rights) (Reclamation

2007).[26] As of 2023, water rights settlements as approved by an Act of Congress involving CAP water have been executed with the Ak-Chin Indian Community, Fort McDowell Yavapai Nation, Gila River Indian Community, San Carlos Apache Tribe, Salt River Pima-Maricopa Indian Community, Tohono O'odham Nation, Yavapai-Prescott Indian Tribe, Hualapai Tribe, and White Mountain Apache Tribe. CAP water is also retained for a future water rights settlement agreement approved by an Act of Congress that settles the Navajo Nation's claims to water in Arizona.

Since the 2007 Interim Guidelines, water rights have been settled or partially settled for three additional Tribes (DOI 2023b). Water rights for the Navajo Nation in New Mexico were settled by the Northwestern New Mexico Rural Water Project Act of 2009 and for the Navajo Nation in Utah by the Navajo Utah Water Rights Settlement in 2022. The White Mountain Apache Tribe Water Rights Quantification Act of 2010 settled water rights for the White Mountain Apache Tribe. Water rights in Arizona for the Hualapai Tribe were settled under the Hualapai Tribe Water Rights Settlement Act of 2022. In addition, the Colorado River Indian Tribes Water Resiliency Act of 2022 authorizes the Colorado River Indian Tribes to enter into lease or exchange agreements, storage agreements, and agreements for conserved water.

Hydroelectric Power and Generation

The Bureau of Indian Affairs operates Headgate Rock Dam and Powerplant, which supplies electricity to the Colorado River Indian Tribes and others (Reclamation 2007). The powerplant depends on Colorado River flows; however, "Reclamation has determined that the water appropriated to non-Colorado River Indian Tribes entities that flows through Headgate Rock Dam and generates powers is not an ITA" (Reclamation 2007) and will not be further discussed in this SEIS.

Cultural and Biological Resources

No cultural or biological resources that were considered ITAs for the 2007 Interim Guidelines analysis were identified by Tribes; however, concerns were expressed regarding TCPs, archaeological sites, sacred sites, fish and wildlife, wildlife habitat, and vegetation (Reclamation 2007).

3.18.2 Environmental Consequences

Methodology

Impacts on ITAs are drawn from several sources, including water deliveries (**Section 3.7**), socioeconomics (**Section 3.16**), and cultural resources (**Section 3.11**). Water deliveries are based on CRMMS modeling assumptions developed for the SEIS.

[26] Each congressionally approved water rights settlement defines the corpus of the trust asset, which as relevant to this analysis includes the specified CAP water entitlement (quantified in acre-feet), and applicable delivery obligations, priorities, and other terms. For those tribes that entered CAP water delivery contracts, but that have not incorporated the CAP water entitlement into a water rights settlement, the CAP contract specifies the CAP entitlement (quantified in acre-feet), and applicable delivery obligations, priorities, and other terms. This analysis does not modify any CAP entitlement or applicable statutory, settlement, or contract terms.

Impact Analysis Area
The impact analysis area consists of Native American Tribes with settled water rights, Native American reservations adjacent to the Colorado River, and the cultural resources analysis area (see **Section 3.10.2**).

Assumptions
The assumptions for the following analysis are:

- Changes in water deliveries will not affect settled water rights.
- Previously gathered data on TCPs and Tribal concerns are sufficient.
- Tribes may supply any additional information they believe should be considered in the ITA assessment.

Impact Indicators
Impact indicators for this analysis are:

- Changes in water allocations due to shortages
- Access changes to sacred sites
- Negative effects on TCPs not discussed in the 2007 FEIS or LTEMP

Issue 1: How would management of Colorado River allocations affect Tribal water rights and allocations?

Summary
Tribal water rights are established by law; however, annual water deliveries may change as a result of shortages and conservation measures. The Proposed Action may result in decreased water deliveries to Tribes that have agreed to conservation measures. This means under the Proposed Action more Tribes—those who participate in conservation measures—may have decreased deliveries in comparison to the No Action Alternative at a given surface water elevation at Lake Mead.

Water rights for individual Tribes are established by law. The determination of water allocations to individual entities is beyond the scope of this SEIS. As with the 2007 Interim Guidelines, "no vested water right of any kind, quantified or unquantified, including federally reserved Indian rights to Colorado River water, rights pursuant to the Consolidated Decree or Congressionally-approved water right settlements utilizing CAP water, will be altered as a result of any of the alternatives under consideration" (Reclamation 2007). A discussion of potential impacts on Tribal agricultural lands by alternative can be found in **Section 3.17**, Environmental Justice, in this SEIS.

See also **Section 3.7**, Water Deliveries, for a full discussion of impacts on water deliveries to all parties, as well as **Appendix E**, Shortage Allocation Model Documentation.

No Action Alternative
Under the No Action Alternative, water deliveries for Tribes follow the 2007 Interim Guidelines as analyzed in Section 4.10.1 of the 2007 FEIS (Reclamation 2007), the DCPs, and the current conservation measures agreed to by the Fort McDowell Yavapai Nation and the GRIC. Water deliveries to Tribes will fluctuate with water availability in Lake Powell and Lake Mead, as they will

fluctuate for all entities that receive water from the Colorado River. Initially, water deliveries may remain near long-term averages, but reduced deliveries may occur if lake levels decline. Any water available will be distributed by priority among and within each state. As discussed in **Section 3.17.2**, Environmental Justice, this means that Tribes in Arizona who hold entitlements to CAP NIA-A priority water may have their available CAP NIA-A priority water reduced to zero if shortages reach a threshold level and Tribes with Arizona fourth priority water may also have their water reduced. In addition, shortages based on priority may result in the loss of production for Tribal agricultural lands. Any annual variability in water deliveries will not affect the underlying settled water rights.

Proposed Action

Under the Proposed Action, impacts would be the same as under the No Action Alternative; however, additional system conservation measures that would reduce water deliveries may be necessary if Lake Mead drops below 1,025 feet. Three additional Tribes (the Colorado River Indian Tribes, San Carlos Apache Tribe, and Quechan Indian Tribe) have agreed to voluntary conservation measures. Tribes that participate in the system conservation would be compensated.

Cumulative Effects

Reclamation has identified one past, present, and reasonably foreseeable future project that may, in conjunction with the proposed near-term Colorado River operations, contribute to cumulative effects on ITAs; this is the LTEMP SEIS. Reclamation is proposing to regulate flows from the Glen Canyon Dam to control smallmouth bass populations and implement more HFEs to deposit sediment along sandbars and beaches. These proposed actions would not contribute to cumulative impacts on water deliveries. No cumulative impacts on water deliveries to Tribes are anticipated.

No cumulative effects would occur on water deliveries to Tribes due to the proposed management activities planned in the Salton Sea 10-Year Plan or the environmental assessment for the implementation of the 10-Year Plan's projects. No cumulative impacts would result as the Proposed Action is not adding additional impacts to those that are already occurring; however, these impacts might occur sooner under the Proposed Action.

Issue 2: How would management of Lake Powell and Lake Mead water flows and lake levels affect cultural resources or biological resources?

Summary

Previously inaccessible sacred sites at Lake Mead would be more accessible to visitation under both alternatives. No other impacts are expected.

No Action Alternative

Under the No Action Alternative, decreases in the pool elevations at Lake Mead may increase visitor access to sacred sites that were previously inaccessible or under water (see **Section 3.11.2**, above). No impacts on important elements of TCPs important to Native Americans, such as plants or animals, are anticipated for the No Action Alternative.

Proposed Action

Impacts on sacred sites and TCPs are the same under the Proposed Action as the No Action Alternative.

Cumulative Effects

Reclamation is proposing to regulate flows from the Glen Canyon Dam to control smallmouth bass populations and implement more HFEs to deposit sediment along sandbars and beaches. The proposed releases are within the previously approved flows analyzed in the LTEMP FEIS, but they may impact TCPs important to Native Americans. Adverse effects on TCPs, as historic properties, will be resolved under the LTEMP PA, land management agency actions, and the nonnative fish MOA in development. These effects should not contribute to cumulative impacts.

Adverse effects on TCPs are not anticipated from the proposed near-term Colorado River operations; however, if adverse effects are present, they will be resolved either under the LTEMP PA, Section 106 of the NHPA process, or the PA under development for this SEIS. Therefore, the proposed near-term Colorado River operations will not contribute to cumulative impacts on ITAs.

No cumulative effects would occur on TCPs due to the proposed management activities planned in the Salton Sea 10-Year Plan or the environmental assessment for the implementation of the 10-Year Plan's projects. No cumulative impacts would result as the Proposed Action is not adding additional impacts to those that are already occurring; however, these impacts might occur sooner under the Proposed Action.

Chapter 4. Consultation and Coordination

4.1 Introduction

This chapter describes Reclamation's public involvement program and coordination with specific federal, state, and local agencies, along with Tribal consultations.

4.2 General Public Involvement Activities

The public involvement program leading to this Revised Draft SEIS included project scoping, consultation, and coordination with Tribes, agencies, stakeholders, and the public. Reclamation developed and implemented a public involvement plan to satisfy the public participation requirements set forth in NEPA and to establish a consistent and constant level of engagement with interested parties and stakeholders. The multifaceted approach consisted of informational materials, consultation and coordination meetings, general and stakeholder outreach, and media relations.

A variety of informational materials to educate and inform audiences about the study and related issues were employed. A website was established and maintained for this SEIS. It contained project documents, points of contact, and the project schedule. An electronic mailing list was used to notify interested parties of website postings, project meetings, and documents. A project email account was maintained live during the entire period of preparing this SEIS for interested parties to express opinions, ask questions, and submit comments.

Reclamation published an NOI to prepare an SEIS and a modified Record of Decision for the 2007 Interim Guidelines in the *Federal Register* on November 17, 2022. A 30-day scoping comment period was held from November 17, 2022, to December 20, 2022. Reclamation notified interested parties of the NOI and scoping comment period through an email notification to the project mailing list on December 1, 2022. The email consisted of an NOI and information on two public webinars.

Reclamation held two virtual public webinars during the scoping period. One meeting was held on November 29, 2022, from 10:00 a.m. to noon mountain standard time, and 184 people attended. The second virtual public meeting was held on December 2, 2022, from 11:00 a.m. to 1:00 p.m. mountain standard time, and 241 people attended. The webinars included an opening statement, a presentation that summarized the NOI, a range of hydrologic and operational scenarios that informed people about the SEIS analysis, an overview of potential alternatives being considered in the SEIS, information on the SEIS process schedule, and a question-and-answer session. The webinars were recorded and published on the project website.[1] Public comments were accepted during the comment period by email and mail. A scoping summary report was prepared to summarize all public comments received during scoping. Reclamation made the public scoping

[1] https://www.usbr.gov/ColoradoRiverBasin/SEIS.html

comments and the scoping summary report available for public viewing in an accessible format on the project website.

On April 14, 2023, the EPA published a Notice of Availability in the *Federal Register* for the original Draft SEIS. This kicked off a 45-day public review and comment period that ended on May 30, 2023. In May 2023, Reclamation held four virtual public meetings to provide information on the original Draft SEIS, answer questions, and take verbal comments. Each meeting presentation covered the same information. The question-and-answer and public comment portions of the meetings varied based on the public participants at each meeting. The webinars were recorded and published on the project website.

On May 22, 2023, representatives from the seven Colorado River Basin States proposed a new alternative for consensus-based system conservation in the Lower Basin. Reclamation filed with the EPA to withdraw the original Draft SEIS from public review. This resulted in the revision and reissuance of the Revised Draft SEIS. Public comments received on the original Draft SEIS were reviewed, and they helped inform the revision of this Draft SEIS.

On October 27, 2023, the EPA published a Notice of Availability in the *Federal Register* for the Revised Draft SEIS. This kicked off a 45-day public review and comment period that ended on December 11, 2023. Reclamation also issued press releases and an email notification via the project mailing list. Two virtual public webinars were conducted during the review period to provide additional information and answer questions. A detailed overview of the public review process and comments received is provided in the Response to Public Comments report (**Appendix H**).

4.3 Cooperating Agency Involvement

In compliance with NEPA and its implementing regulations, Reclamation worked with five cooperating agencies in the preparation of this SEIS. As described in **Chapter 1**, cooperating agencies included the BIA, Service, NPS, WAPA, and USIBWC. In developing the Draft SEIS, Reclamation hosted seven cooperating agency virtual meetings to obtain data, information, resource analysis, and review of internal documents. Additionally, individual agencies provided specific assistance, including the following:

- The BIA administers the federal trust responsibility to Indian Tribes.
- The Service has jurisdiction by law and special expertise with respect to the ESA and biological resources within the study area and its administration of several wildlife refuges in the study area. The Service provided resource expertise and worked closely with Reclamation in developing two biological assessments to support consultation under Section 7 of the ESA.
- Given its jurisdiction of NPS units within the Basin and administration of recreation on Lake Powell and Lake Mead, the NPS provided data and analysis of potential impacts on resources under its management.
- The WAPA provided hourly release volume models for Glen Canyon Dam to aid in resource-specific modeling. The WAPA also provided hydroelectric modeling to assess

impacts on power generation and revenue across the major generation facilities in the Upper and Lower Basins.

- The USIBWC provided guidance and reviewed internal documents to ensure the SEIS adequately addressed treaty obligations and international commitments. The USIBWC has worked with Reclamation to ensure that Mexico has been kept informed of all permissibly available information regarding the SEIS process.

While not a cooperating agency, the USGS also contributed expertise and resource modeling support.

4.4 Tribal Consultation and Coordination

For purposes of this NEPA process, Reclamation is consulting and coordinating with Tribes who have entitlements to or contracts for Colorado River water and those that may be affected by or have interests in the proposed federal action. Representatives of various Indian Tribes also attended the scoping meetings in November and December 2022. Eighteen Tribes provided Reclamation with written comments on the proposed federal action and its potential effects on resources of Tribal concern, including ITAs.

4.4.1 Summary of Tribal Consultation and Coordination

There are many federally recognized Tribes with entitlements to or contracts for Colorado River water or who may be affected or have interests in the proposed federal action. There are 30 federally recognized Tribes within the geographic Basin. Reclamation consults regularly with these Tribes regarding Colorado River issues. These Tribes are listed in **Table 4-1** and shown on **Map 4-1**.

Table 4-1
Basin Tribes

- Ak-Chin Indian Community
- Chemehuevi Indian Tribe
- Cocopah Indian Tribe
- Colorado River Indian Tribes
- Fort McDowell Yavapai Nation
- Fort Mojave Indian Tribe
- Gila River Indian Community
- Havasupai Tribe
- Hopi Tribe
- Hualapai Indian Tribe
- Jicarilla Apache Nation
- Kaibab Band of Paiute Indians
- Las Vegas Tribe of Paiute Indians
- Moapa Band of Paiute Indians
- Navajo Nation
- Paiute Indian Tribe of Utah
- Pascua Yaqui Tribe
- Quechan Indian Tribe
- Salt River Pima-Maricopa Indian Community
- San Carlos Apache Tribe
- San Juan Southern Paiute
- Southern Ute Indian Tribe
- Tohono O'odham Nation
- Tonto Apache Tribe
- Ute Indian Tribe of the Uintah and Ouray Reservation
- Ute Mountain Ute Tribe
- White Mountain Apache Tribe
- Yavapai-Apache Nation
- Yavapai-Prescott Indian Tribe
- Zuni Tribe

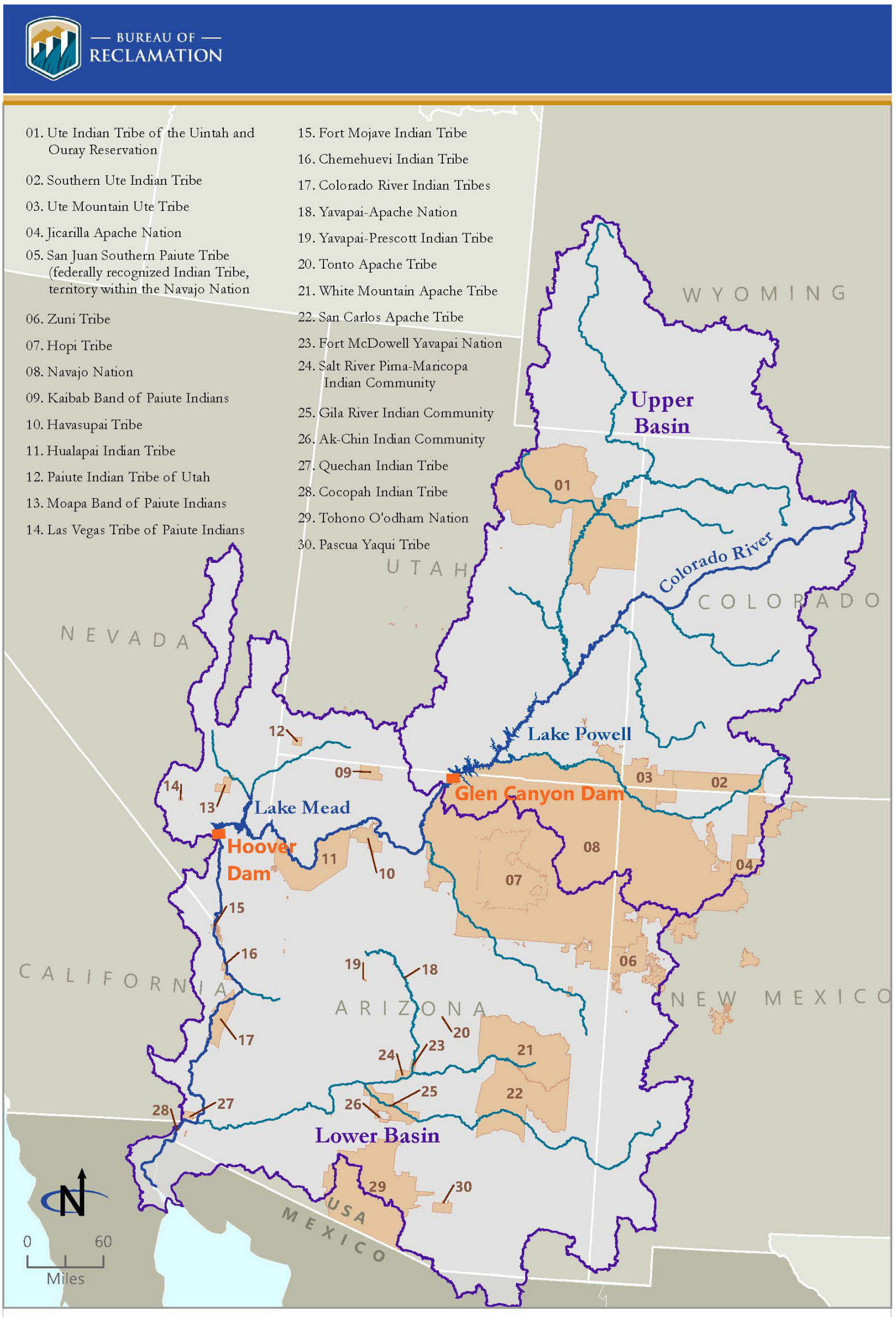
The Ten Tribes Partnership is a coalition of 10 federally recognized Tribes with rights and unresolved claims to Colorado River water. The partnership was created in 1992 and has an ongoing consultation relationship with Reclamation. Federally recognized Tribes of the Ten Tribes Partnership are listed in **Table 4-2**.

Table 4-2
Ten Tribes Partnership Tribes

- Ute Mountain Ute Tribe
- Southern Ute Indian Tribe
- Ute Indian Tribe of the Uintah and Ouray Reservation
- Jicarilla Apache Nation
- Navajo Nation
- Fort Mojave Indian Tribe
- Colorado River Indian Tribes
- Chemehuevi Indian Tribe
- Quechan Indian Tribe
- Cocopah Indian Tribe

Of the 22 federally recognized Tribes in Arizona, 14 have fully resolved, adjudicated rights, or partially resolved rights to water from the Colorado River. A significant portion of that water is provided through the CAP. Reclamation has a long-standing and ongoing consultation relationship with Tribes receiving Colorado River water through the CAP. **Table 4-3** lists CAP Tribes.

Map 4-1
Colorado River Basin Tribes



Map 4-1 Colorado River Basin Tribes

- Tribal Reservation and off-reservation trust land
- Colorado River
- Colorado River tributary
- Dam
- Colorado River Basin, Upper and Lower Basins
- States in the Colorado River Basin

Source: National Weather Service GIS. 2023, Reclamation GIS 2023, USGS National Hydrography Dataset GIS. 2023; Map production: U.S. Department of the Interior, Bureau of Reclamation, Upper and Lower Colorado Basin Regions; Date: March 25, 2023, Disclaimer: This map is intended for informational purposes only. Geographic features may have been compiled at varying scales and for different purposes. No representation is made as to the accuracy of this graphic.

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Table 4-3
CAP Tribes

- Ak-Chin Indian Community
- Fort McDowell Yavapai Nation
- Gila River Indian Community
- Hualapai Tribe
- Pascua Yaqui Tribe
- Salt River Pima-Maricopa Indian Community
- San Carlos Apache Tribe
- Tohono O'odham Nation
- Tonto Apache Tribe
- White Mountain Apache Tribe
- Yavapai-Apache Nation
- Yavapai-Prescott Tribe

Reclamation consults not only with Tribes who hold water rights or are located within the geographic boundary of the Basin, but also Tribes who may be affected or have interests in actions on the Colorado River. **Table 4-4** lists the 43 federally recognized Tribes with whom Reclamation consults on issues regarding the Colorado River.

Table 4-4
Tribes Consulted on Colorado River Issues

- Ak-Chin Indian Community
- Chemehuevi Indian Tribe
- Cocopah Tribe of Arizona
- Colorado River Indian Tribes
- Fort McDowell Yavapai Nation
- Fort Mojave Indian Tribe
- Gila River Indian Community
- Havasupai Indian Tribe
- Hopi Tribe
- Hualapai Indian Tribe
- Jicarilla Apache Nation
- Kaibab Band of Paiute Indians
- Las Vegas Tribe of Paiute Indians
- Moapa Band of Paiute Indians
- Navajo Nation
- Paiute Indian Tribe of Utah
- Pascua Yaqui Tribe
- Pueblo of Acoma
- Pueblo of Cochiti
- Pueblo of Jemez
- Pueblo of Laguna
- Pueblo of Nambe
- Pueblo of Pojoaque
- Pueblo of San Felipe
- Pueblo of San Juan
- Pueblo of Sandia
- Pueblo of Santa Ana
- Pueblo of Santa Clara
- Pueblo of Tesuque
- Pueblo of Zia
- Quechan Indian Tribe
- Salt River Pima-Maricopa Indian Community
- San Carlos Apache Tribe
- San Juan Southern Paiute Tribe
- Southern Ute Indian Tribe
- Tohono O'odham Nation
- Tonto Apache Tribe
- Ute Indian Tribe of the Uintah and Ouray Reservation
- Ute Mountain Ute Tribe
- White Mountain Apache Tribe
- Yavapai-Apache Nation
- Yavapai-Prescott Tribe
- Zuni Tribe

4.4.2 Tribal Consultation Efforts

An NOI to prepare this SEIS was published in the *Federal Register* on November 17, 2022. Since that date, Reclamation has engaged regularly with the Tribes described above. **Table 4-5** provides a summary of those Tribal consultation and coordination efforts conducted by Reclamation between publication of the NOI and August 30, 2023.

Table 4-5
Summary of Tribal Consultation Efforts

Date	Meeting Title/Subject of Correspondence	Purpose	Tribes Invited
11/17/2022	Basin Tribal Information Exchange	Monthly meeting	Tribal leaders and representatives for Tribes throughout the Basin
11/22/2022	SEIS NOI Publication and Public Scoping Webinar Information Email Notification	Email communicating the Department's SEIS NOI publication in the *Federal Register* on November 17, 2022, and sharing of the upcoming scoping webinar information for the SEIS	Tribal leaders and representatives for Tribes throughout the Basin
11/23/2022	SEIS NOI Publication and Public Scoping Webinar Information Email Notification	Email communicating the Department's SEIS NOI publication in the *Federal Register* on November 17, 2022, and sharing of the upcoming scoping webinar information for the SEIS	San Juan-Chama project stakeholders
11/28/2022	SEIS NOI Publication, Purpose, and Public Scoping Process Correspondence	Letter from regional directors communicating the Department's SEIS NOI publication in the *Federal Register* on November 17, 2022, its purpose, and information on the scoping process for the SEIS	Tribal leaders for Tribes throughout the Basin
12/9/2022	Inter-Tribal Council of Arizona (ITCA) Tribal Leaders Water Policy Council and Colorado River Tribal Roundtable Meeting	Special ITCA meeting with all Basin Tribal leaders to provide an update on the SEIS NOI and scoping and an update on the post-2026 process	The ITCA extended an invitation outside Arizona to all Tribal leaders and representatives for Tribes throughout the Basin.
12/14/2022	Quechan Indian Tribe Meeting	Meeting with the Department and Reclamation leadership to discuss current issues on the Basin, including the SEIS scoping process and relevant information	Quechan Indian Tribe
12/15/2022	Ten Tribes Partnership Meeting	Bimonthly meeting with member Tribes of the Ten Tribes Partnership	The 10 member Tribes of the Ten Tribes Partnership

Date	Meeting Title/Subject of Correspondence	Purpose	Tribes Invited
12/15/2022	Upper Basin Tribe Meeting	Meeting with Department and Reclamation leadership to discuss current issues on the Basin, including the SEIS scoping process and relevant information	Jicarilla Apace Nation, Navajo Nation, Paiute Indian Tribe of Utah, Southern Ute Indian Tribe, Ute Indian Tribe, and Ute Mountain Ute Tribe
12/15/2022	Navajo Nation Meeting	Meeting with Department and Reclamation leadership to discuss current issues on the Basin, including the SEIS scoping process and relevant information	Navajo Nation
12/15/2022	Ute Mountain Ute Tribe Meeting	Meeting with Department and Reclamation leadership to discuss current issues on the Basin, including the SEIS scoping process and relevant information	Ute Mountain Ute Tribe
12/15/2022	Colorado River Indian Tribes Meeting	Meeting with Department and Reclamation leadership to discuss current issues on the Basin, including the SEIS scoping process and relevant information	Colorado River Indian Tribes
12/15/2022	Jicarilla Apache Nation Meeting	Meeting with Department and Reclamation leadership to discuss current issues on the Basin, including the SEIS scoping process and relevant information	Jicarilla Apache Nation
12/15/2022	Ute Indian Tribe Meeting	Meeting with Department and Reclamation leadership to discuss current issues on the Basin, including the SEIS scoping process and relevant information	Ute Indian Tribe of the Uintah and Ouray Reservation
12/15/2022	Gila River Indian Community Consultation	The Gila River Indian Community requested government-to-government consultation to discuss the SEIS scoping process; relevant information to the SEIS process, such as hydrologic updates; and other system conservation offers.	Gila River Indian Community

Date	Meeting Title/Subject of Correspondence	Purpose	Tribes Invited
12/15/2022	Southern Ute Indian Tribe Consultation	Meeting with Department and Reclamation leadership to discuss current issues on the Basin, including the SEIS scoping process and relevant information	Southern Ute Indian Tribe
1/13/2023	Southern Ute Indian Tribe Consultation	The Southern Ute Indian Tribe Council requested a meeting with Upper Basin regional leadership to discuss the contents of the Southern Ute Indian Tribe's SEIS scoping comment letter.	Southern Ute Indian Tribe
1/19/2023	Basin Tribal Information Exchange	Monthly meeting	Tribal leaders and representatives for Tribes throughout the Basin
2/8/2023	Ten Tribes Partnership Meeting	Bimonthly meeting with member Tribes of the Ten Tribes Partnership	The 10 member Tribes of the Ten Tribes Partnership
3/7/2023	SEIS Process and Tribal Consultation Timeline Correspondence	Letter from regional directors communicating Reclamation's planned timeline and process for government-to-government consultation on the Draft SEIS	Tribal leaders and representatives for Tribes throughout the Basin
3/17/2023	Upper Basin Tribes-States Dialogue Meeting	Reclamation invited to participate in semi-regular meeting between Upper Basin Tribes and States	Leaders and representatives of the six Upper Basin Tribes
3/23/2023	Basin Tribal Information Exchange	Monthly meeting	Tribal leaders and representatives for Tribes throughout the Basin
4/11/2023	Colorado River/SEIS Press Event	Press event at Glen Canyon Dam to announce the release of the Draft SEIS	Cocopah (representing Colorado River Basin Tribes)
4/11/2023	Colorado River Basin Tribal Information Exchange	Monthly meeting	Tribal Leaders and Representatives for Tribes throughout the Colorado River Basin
4/12/2023	Ten Tribes Partnership Meeting	Bimonthly meeting with member Tribes of the Ten Tribes Partnership	The 10 member Tribes of the Ten Tribes Partnership
4/25/2023	Ak-Chin Indian Community SEIS Consultation	Government-to-government consultation on the Draft SEIS in Maricopa, Arizona	Ak-Chin Indian Community

Date	Meeting Title/Subject of Correspondence	Purpose	Tribes Invited
4/27/2023	Navajo Nation SEIS Technical Briefing	Navajo Nation requested an individual briefing on the Draft SEIS document.	Navajo Nation
4/28/2023	Chemehuevi Indian Community SEIS Consultation	Briefing to the council on the Draft SEIS in Havasu Lake, California	Chemehuevi Indian Tribe
5/1/2023	Navajo Nation SEIS Consultation	Government-to-government consultation on the Draft SEIS in Window Rock, Arizona	Navajo Nation
5/2/2023	Jicarilla Apache Nation SEIS Consultation	Government-to-government consultation on the Draft SEIS in Dulce, New Mexico	Jicarilla Apache Nation
5/3/2023	Tohono O'odham SEIS Consultation	Government-to-government consultation on the Draft SEIS in Sells, Arizona	Tohono O'odham Nation
5/4/2023	Southern Ute Indian Tribe SEIS Consultation	Government-to-government consultation on the Draft SEIS in Ignacio, Colorado	Southern Ute Indian Tribe
5/4/2023	Gila River Indian Community SEIS Consultation	Government-to-government consultation on the Draft SEIS in Phoenix, Arizona	Gila River Indian Community
5/5/2023	Ute Mountain Ute Tribe SEIS Consultation	Government-to-government consultation on the Draft SEIS in Towaoc, Colorado	Ute Mountain Ute Tribe
5/9/2023	Colorado River Indian Tribes SEIS Consultation	Government-to-government consultation on the Draft SEIS in Parker, Arizona	Colorado River Indian Tribes
5/10/2023	Fort Mojave Indian Tribe SEIS Consultation	Government-to-government consultation on the Draft SEIS in Needles, California	Fort Mojave Indian Tribe
5/10/2023	Upper Basin Tribes-States Dialogue Meeting	Reclamation invited to participate in semi-regular meeting between Upper Basin Tribes and States. The meeting included a briefing on the Draft SEIS.	Upper Basin Tribes (SUIT, Ute Mountain Ute Tribe, Ute Indian Tribe, Jicarilla-Apache Nation, Navajo Nation, and Paiute Indian Tribe of Utah)
5/11/2023	Hopi Tribe SEIS Consultation	Government-to-government consultation (virtual) on the Draft SEIS	Hopi Tribe
5/15/2023	Hualapai Tribe SEIS Consultation	Government-to-government consultation (virtual) on the Draft SEIS	Hualapai Tribe
5/16/2023	Yavapai-Apache Nation SEIS Consultation	Government-to-government consultation (virtual) on the Draft SEIS	Yavapai-Apache Nation

Date	Meeting Title/Subject of Correspondence	Purpose	Tribes Invited
5/17/2023	Colorado River Basin Tribal Information Exchange	Monthly meeting	Tribal leaders and representatives for Tribes throughout the Colorado River Basin
5/23/2023	San Carlor Apache Tribe SEIS Consultation	Government-to-government consultation on the Draft SEIS in San Carlos, Arizona	San Carlos Apache Tribe
5/24/2023	Cocopah Indian Tribe SEIS Consultation	Government-to-government consultation on the Draft SEIS in Yuma, Arizona	Cocopah Indian Tribe
5/24/2023	Quechan Indian Tribe SEIS Consultation	Government-to-government consultation on the Draft SEIS in Winterhaven, California	Quechan Indian Tribe
5/25/2023	Gila River Indian Community Second SEIS Consultation	Government-to-government consultation on the Draft SEIS in Chandler, Arizona	Gila River Indian Community
5/26/2023	Pascua Yaqui Tribe SEIS Consultation	Government-to-government Consultation (virtual) on the Draft SEIS	Pascua Yaqui Tribe
6/13/2023	Meeting with Gila River Indian Community	Virtual meeting	Gila River Indian Community
6/14/2023	Ten Tribes Partnership Meeting	Bimonthly meeting with member Tribes of the Ten Tribes Partnership	The 10 member Tribes of the Ten Tribes Partnership
6/15/2023	Colorado River Basin Tribal Information Exchange	Monthly meeting	Tribal leaders and representatives for Tribes throughout the Colorado River Basin
6/15/2023	Southern Ute Indian Tribe Visit	Southern Ute invited Upper Colorado Basin leadership to meet with the council to discuss the Colorado River, Tribal water infrastructure needs, and tour projects on the reservation.	Southern Ute Indian Tribe
7/20/2023	Colorado River Basin Tribal Information Exchange	Monthly meeting	Tribal leaders and representatives for Tribes throughout the Colorado River Basin
7/28/2023	SEIS Modeling Assumptions Technical Meeting for Tribes	Meeting with Colorado River Basin Tribal technical and legal representatives to discuss modeling assumptions used in the revised Draft SEIS	Tribal leaders and representatives for Tribes throughout the Colorado River Basin

Date	Meeting Title/Subject of Correspondence	Purpose	Tribes Invited
8/4/2023	Technical SEIS Meeting for Tribes	Meeting with Colorado River Basin Tribes to share the new Lower Basin States alternative modeling assumptions and results	Tribal leaders and representatives for Tribes throughout the Colorado River Basin
8/8/2023	Meeting with Gila River Indian Community	Hybrid meeting; in person in Washington, DC	Gila River Indian Community
8/9/2023	Ten Tribes Partnership Meeting	Bimonthly meeting with member Tribes of the Ten Tribes Partnership	The 10 member Tribes of the Ten Tribes Partnership
8/9/2023	Ak-Chin Indian Community SEIS Consultation	Government-to-government consultation on the Draft SEIS in Maricopa, Arizona	Ak-Chin Indian Community
8/24/2023	Colorado River Basin Tribal Information Exchange	Monthly meeting	Tribal leaders and representatives for Tribes throughout the Colorado River Basin
8/29/2023	Jicarilla Apache Nation Visit	Jicarilla Apache invited Upper Colorado Basin leadership to meet with the council to discuss the Colorado River and Tribal concerns	Jicarilla Apache Nation
8/30/2023	Ute Mountain Ute Tribe Visit	Ute Mountain Ute invited Upper Colorado Basin leadership to meet with the council to discuss the Colorado River, Tribal water infrastructure needs, and tour projects on the reservation.	Ute Mountain Ute Tribe
9/21/2023	Colorado River Basin Tribal Information Exchange	Monthly Meeting	Tribal leaders and representatives for Tribes throughout the Colorado River Basin
9/28/2023	Gila River Indian Community SEIS Consultation	Government-to-government consultation on the Draft SEIS; Hybrid; in person in Washington, DC	Gila River Indian Community
10/19/2023	Colorado River Basin Tribal Information Exchange	Monthly Meeting	Tribal leaders and representatives for Tribes throughout the Colorado River Basin
10/20/2023	SEIS Modeling Meeting	Meeting with Navajo Nation technical and legal representatives to discuss modeling assumptions used in the revised Draft SEIS	Navajo Nation

Date	Meeting Title/Subject of Correspondence	Purpose	Tribes Invited
10/25/2023	Ten Tribes Partnership Meeting	Bimonthly meeting with member Tribes of the Ten Tribes Partnership	The 10 member Tribes of the Ten Tribes Partnership
11/3/2023	Interim Guidelines Draft SEIS Tribal Briefing	Technical overview of revised draft SEIS for the CRB Tribes	Tribal leaders and representatives for Tribes throughout the Colorado River Basin
11/8/2023	Gila River Indian Community SEIS Consultation	Government-to-government consultation on the revised Draft SEIS (virtual consultation)	Gila River Indian Community
12/1/2023	Tohono O'odham Nation SEIS Consultation	Government-to-government consultation on the revised Draft SEIS (virtual consultation)	Tohono O'odham Nation
12/6/2023	Southern Ute Indian Tribe SEIS Consultation	Government-to-government consultation on the revised Draft SEIS (virtual consultation)	Southern Ute Indian Tribe
12/8/2023	Navajo Nation SEIS Consultation	Government-to-government consultation on the revised Draft SEIS (virtual consultation)	Navajo Nation
12/13/2023	Ten Tribes Partnership Meeting	Bimonthly meeting with member Tribes of the Ten Tribes Partnership	The 10 member Tribes of the Ten Tribes Partnership

4.5 Endangered Species Act Section 7 Consultation

In 2007, the Service finalized ESA Section 7 consultation for the Interim Guidelines due to impacts on the threatened and endangered species described in **Section 3.13.1**. This SEIS to the Interim Guidelines effectively requires reinitiation of the 2007 consultation. In addition, in the Lower Basin, MSCP consultation biological opinions were issued in 2004, 2018, and 2022. Reclamation is consulting on the following action in the Lower Colorado River Basin that is not currently covered in existing biological opinions: 1) increasing the amount of reduction in flow coverage provided under the LCR MSCP in Reaches 2 through 5 (from Hoover Dam to Imperial Dam) in the range of 2.083 to 2.5 maf per year, from the current coverage of 1.574 maf per year; and 2) implementing proposed conservation measures, including minimization measures, additional monitoring and research, and habitat creation as an integral part of the proposed action to fully offset the potential effects on species and their habitats associated with the requested increases in flow reductions. For the Upper Basin, the LTEMP biological opinion (BO;USFWS 2016) considered monthly, daily, and hourly operations based on annual release volumes listed in the 2007 Interim Guidelines with

minimum annual releases of 7.0 maf. In the Upper Basin, Reclamation is consulting on releases between 6.0 and 7.0 maf per year while maintaining LTEMP minimum flows, operational constraints, and prudent operations.

ESA Section 7 interagency consultations (16 USC 1531) were initiated with the Service in January 2023. They continued through a series of meetings and email exchanges, during which listed species were identified, actions and action areas were discussed, and conservation measures were developed. Two biological assessments were developed, one for the Lower Colorado River[2] in relation to the MSCP, and one for the Upper Colorado River[3] in relation to LTEMP. Final biological assessments were submitted to the Service in February 2024 (see **Appendix I**, SEIS Biological Assessments). Consultation is ongoing with an anticipated finalization of two biological opinions in spring 2024.

[2] From Lake Mead to the SIB
[3] Lake Powell, Glen Canyon Dam, and the Colorado River downstream to Lake Mead

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The Draft SEIS was prepared by Reclamation with resource modeling and analysis support from the National Park Service, Northern Arizona University, US Geological Survey, and Western Area Power Administration. This is a list of preparers who developed significant background material and various sections or they participated, to a significant degree, in the preparation of this Draft SEIS.

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Glossary

acre-foot (af)—Volume of water (43,560 cubic feet) that would cover 1 acre to a depth of 1 foot.

adaptive management—A method for examining alternative strategies for meeting measurable biological goals and objectives, and then, if necessary, adjusting future conservation management actions according to what is learned.

affected environment—Existing biological, physical, social, and economic conditions of an area that are subject to change, both directly and indirectly, as the result of a proposed human action.

algae—Simple plants containing chlorophyll; most live submerged in water.

allocation, allotment—Refers to a distribution of water through which specific persons or legal entities are assigned individual rights to consume pro rata shares of a specific quantity of water under legal entitlements. For example, a specific quantity of Colorado River water is distributed for use within each Lower Division State through an apportionment. Water available for consumptive use in that state is further distributed among water users in that state through the allocation. An allocation does not establish an entitlement; the entitlement is normally established by a written contract with the United States government. *See also* Lower Division States.

alluvium—Sedimentary material transported and deposited by the action of flowing water.

ambient—Surrounding natural conditions (or environment) in a given place and time.

amphibian—A vertebrate animal that has a life stage in water and a life stage on land. (Examples include salamanders, frogs, and toads.)

annual flow-weighted average concentration—A weighted average of monthly total dissolved solids (TDS) concentrations for a year, where the weight for each month is based on the relative flow for each month.

Annual Operating Plan for Colorado River Reservoirs (AOP)—A document describing how Reclamation will manage Colorado River resources over a 12-month period, consistent with the Long-Range Operating Criteria and the *Arizona v. California* 1964 Supreme Court Decree. The AOP is prepared annually by Reclamation in cooperation with the Basin States, Mexico, appropriate federal agencies, Indian Tribes, state and local agencies, and the general public, including governmental interests, as required by federal law. As part of the AOP process, the Secretary of the Department of the Interior (Secretary) makes annual determinations regarding the availability of Colorado River water for deliveries to the Lower Division States of the Colorado River Basin. *See also* Lower Division States.

apportionment—Refers to the distribution of water available to each Lower Division State in Normal, Surplus or Shortage condition years, as set forth, respectively, in Articles II(B)(1), II(B)(2), and II(B)(3) of the 1964 Supreme Court Decree in the case of *Arizona v. California.*

appropriative rights—The right to divert a specified quantity of water at a specified point of diversion for reasonable and beneficial uses at a specified place of use for a specified manner of use. Appropriative rights are generally "first-in-time, first-in-right"(that is, one appropriative right has priority over appropriative rights established later).

backwater—A relatively small, generally shallow area of a river with little or no current.

banked groundwater—Water that has been stored temporarily in a groundwater aquifer. Banked groundwater can be recovered for use at a later time.

base load—Minimum load in a power system over a given period of time.

Basin States—In accordance with the Colorado River Compact of 1922, the Colorado River Basin within the United States consists of those parts of Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming within and from which waters drain naturally into the Colorado River. These seven states are referred to as the Basin States. *See also* Colorado River Compact of 1922.

biological assessment (BA)—A document identifying the likely effects of a proposed federal action on threatened and endangered species. To facilitate compliance with Section 7(a)(2) of the Endangered Species Act (ESA), federal agencies must prepare a BA pursuant to Section 7(c)(1) of the ESA. *See also* Endangered Species Act.

biological opinion (BO)—A document stating the opinion of the United States Fish and Wildlife Service (Service) and/or the National Marine Fisheries Service as to whether a federal action is likely to jeopardize the continued existence of a threatened or endangered species or result in the destruction or adverse modification of critical habitat.

bypass flows—Saline agricultural return flows from the Wellton-Mohawk Irrigation and Drainage District that are routed to the Cienega de Santa Clara in Mexico to ensure compliance with the salinity provisions of Minute 242 of the 1944 Water Treaty.

bypass tubes—Another term for river outlet works.

candidate species—A plant or animal species that is not yet officially listed as threatened or endangered under the ESA but is undergoing status review by the Service.

capacity—The maximum amount of energy that can be instantaneously produced.

catch—At a recreational fishery, refers to the number of fish captured, whether they are kept or released.

channel (watercourse)—An open conduit either naturally or artificially created that periodically or continuously contains moving water, or that forms a connecting link between two bodies of water.

Some terms used to describe natural channels are river, creek, run, branch, and tributary. Natural channels may be single or braided. Two terms used to describe artificial channels are canal and floodway.

Cladophora—Filamentous green alga important to the food chain in the Colorado River downstream of Glen Canyon Dam.

Colorado River Basin (Basin)—The drainage area of the Colorado River system. The Basin occupies an area of approximately 250,000 square miles in the southwestern United States and 3,500 square miles in northwestern Mexico. The Colorado River Compact of 1922 divided the Colorado River system into two subbasins: the Upper Basin and the Lower Basin. It also divided the seven states within the Basin into the Upper Division and the Lower Division. Upper Division States include Colorado, New Mexico, Utah, and Wyoming; Lower Division States include Arizona, California, and Nevada. Additionally, 30 federally recognized Tribes are in the Basin.

Colorado River Basin Project Act of 1968 (CRBPA)—An act authorizing construction of a number of water development projects, including the Central Arizona Project (CAP), and requiring the Secretary to develop the Criteria for Coordinated Long-Range Operation of Colorado River Reservoirs, or Long-Range Operating Criteria (LROC).

Colorado River Basin Salinity Control Forum—The organization dedicated to controlling Colorado River salinity; it consists of representatives of the seven Basin States.

Colorado River Compact of 1922—The agreement concerning the apportionment of the use of the waters of the Colorado River Basin, dated November 24, 1922, and executed by commissioners for Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming. It was approved and proclaimed effective by Herbert Hoover, the president of the United States, and representative of the United States for purposes of the Compact, on June 25, 1929.

Colorado River Simulation System (CRSS)—An operational model of the Colorado River Basin based on a monthly time step.

Colorado River system—The portion of the Colorado River and its tributaries within the United States as defined in the Colorado River Compact of 1922.

compact—The Colorado River Compact of 1922.

compact point—The reference point designated by the Colorado River Compact of 1922 as dividing the Colorado River Basin into two subbasins, the Upper Basin and the Lower Basin. The compact point is Lee Ferry, Arizona. *See also* Lee Ferry Compact Point.

conductivity—A measure of water's ability to pass an electrical current.

Consolidated Decree—A decree entered by the United States Supreme Court on March 27, 2006, in the case of *Arizona v. California,* 547 US 150 (2006), incorporating all applicable provisions of the earlier-issued decisions and decrees in the matter. The Supreme Court reached a decision in the case

of *Arizona v. California* in 1963 and implemented this decision in a 1964 decree, which was supplemented over time after its adoption.

consumptive use—For purposes of this supplemental environmental impact statement (SEIS), diversions of water from mainstream Colorado River, including water withdrawn from the mainstream through underground pumping, minus any measured and unmeasured return flows.

contractors—Those who hold entitlements to Colorado River water. Contractors consist of the federal government, states, Indian Tribes, and various public and private entities that are recognized under the Consolidated Decree, hold a Section 5 Contract with the Secretary, or have a Secretarial Reservation of water. *See also* Consolidated Decree.

conveyance loss—Water that is lost in transit from a pipe, canal, conduit, or ditch by leakage or evaporation. If the water is lost due to leakage, it may be considered return flow if it percolates to an aquifer and is available for reuse. If the water evaporates, it is considered consumptive use.

cooperating agency—With respect to the National Environmental Policy Act of 1969, as amended (NEPA) process, an agency that has jurisdiction by law or special expertise concerning an aspect of a proposed federal action and that is requested by the lead agency to participate in the preparation of an environmental impact statement (EIS).

covered species—Those species addressed in the Lower Colorado River Multi-Species Conservation Program (LCR MSCP) for which conservation measures would be implemented and for which authorization for "take" is being requested under Section 10 of the ESA. *See also* take.

criteria—Standards used for making a determination.

critical habitat—Specific areas with physical or biological features essential to the conservation of a listed species and that may require special management considerations or protection. These areas have been legally designated via *Federal Register* notices.

cubic foot per second (cfs)—A measure of water flow equal to 1 cubic foot of water passing a point on the stream in 1 second of time.

cultural resource—A building, site, district, structure, or object significant in history, architecture, archaeology, culture, or science.

dead pool—Elevation at which water cannot be regularly released from a reservoir, which would effectively preclude Colorado River diversions to downstream users.

dead storage—Reservoir space from which stored water cannot be evacuated by gravity.

delta sediment—Deposit formed at the mouth of the Colorado River and other rivers where they enter Lake Powell, Lake Mead, or the Gulf of California.

depletion—Loss of water from a stream, river, or basin resulting from consumptive use.

deposition—Settlement of material out of the water column and on to the streambed. Occurs when the energy of flowing water is unable to support the load of suspended sediment.

discharge (flow)—Volume of water that passes a given point within a given period of time; expressed in this SEIS in cubic feet per second (cfs). *See also* cubic foot per second.

dissolved oxygen (DO)—Amount of free oxygen found in water; perhaps the most commonly employed measurement of water quality. Low DO levels adversely affect fish and other aquatic life. The ideal dissolved oxygen for fish life is between 7 milligrams per liter (mg/L) and 9 mg/L; most fish cannot survive when DO falls below 3 mg/L.

diversion(s)—Colorado River water withdrawn from the mainstream, including water diverted from reservoirs or drawn from the mainstream by underground pumping.

domestic use—Refers to the use of water for household, stock, municipal, mining, milling, industrial, and other like purposes; excludes the generation of electrical power.

draw down—Lowering of a reservoir's elevation; process of depleting a reservoir or groundwater storage.

ecosystem—Complex system composed of a community of fauna and flora and that system's chemical and physical environments.

electric power system—Physically connected facilities for electricity generation, transmission, and distribution that are operated as a unit under one control.

electrical demand—Energy requirement placed upon a utility's generation at a given instant or averaged over any designated period of time.

endangered species—A species or subspecies whose survival is in danger of extinction throughout all or a significant portion of its range.

Endangered Species Act (ESA)—The Endangered Species Act (ESA) of 1973 (16 USC 1531–1544), as amended; under Section 9, it provides for the prohibition of "take" of any fish or wildlife species listed as threatened or endangered under the ESA unless specifically authorized by regulation. *See also* take.

energy—What is produced by power plants; measured in kilowatt hours.

entitlement—Refers to an authorization to beneficially consume Colorado River water pursuant to a decreed right; a contract with the United States through the Secretary or a Secretarial Reservation of water.

epilimnion—Thermal layering of water in lakes and streams. *See also* stratification.

firm energy or power—Non-interruptible energy or power guaranteed by the supplier to be available at all times except for reasons of uncontrollable forces or "continuity of service" contract provisions.

flood—An overflow or inundation that comes from a river or other body of water, and causes or threatens damage. Any relatively high streamflow overtopping the natural or artificial banks in any reach of a river or stream. A relatively high flow as measured by either gage height or discharge quantity.

flood control pool—Reservoir volume above the active conservation and joint-use pool that is reserved for flood runoff and then evacuated as soon as possible to keep that space ready for the next flood.

flood control release—The release of water from Lake Mead and the operation of Hoover Dam for flood control purposes pursuant to the reservoir operating criteria specified in the February 8, 1984, Field Working Agreement between the United States Army Corps of Engineers (USACE) and the Bureau of Reclamation (Reclamation), and the USACE regulations contained in 33 Code of *Federal Regulations* (CFR) 208.11.

flow—Volume of water passing a given point per unit of time expressed in cubic foot per second. *See also* cubic foot per second.

forage fish—Generally, small fish that reproduce prolifically and are consumed by predators.

fore bay—Impoundment immediately above a dam or hydroelectric plant intake structure. The term is applicable to all types of hydroelectric developments (storage, run-of-river, and pumped storage).

fry—Life stage of fish between the egg and fingerling stages.

full pool—Volume of water in a reservoir at maximum design elevation.

gaging station—Specific location on a stream where systematic observations of hydrologic data are obtained through mechanical or electrical means.

gigawatt-hour (GWh)—One billion watt-hours of electrical energy.

headwater—The source and upper part of a stream.

historic property—Any district, site, building, structure, or object listed on or eligible for listing on the National Register of Historic Places (36 CFR 800.16(l)(1)).

hydropower—The use of water to produce electricity.

hypolimnetic zone—The deep portion of a lake or reservoir volume generally classified as below the level of the thermocline.

hypolimnion—Thermal layering of water in lakes and streams; the lower stratum of the water column of a reservoir. This layer is generally undisturbed, and respiration and decomposition predominate. *Also see* stratification.

important farmlands—Prime farmland, unique farmland, farmland of statewide importance, and farmland of local importance, as defined by the United States Department of Agriculture Natural Resources Conservation Service (formerly the Soil Conservation Service). The categorization of farmland is based on a soil classification system that accounts for the physical and chemical characteristics of the land and the suitability of the land for producing crops. Important farmlands are afforded special protection due to their importance to agricultural production.

impoundment—Body of water created by a dam.

in situ—In archaeology, and as used in this SEIS, an artifact that has not been moved from its original place of deposit.

incidental take—Defined under the ESA as take that is "incidental to, and not the purpose of, the carrying out of an otherwise lawful activity" (50 CFR 17.22 and 17.32). *See also* take.

Indian trust assets (ITAs)—"legal interests" in "assets" held in "trust" by the federal government for federally recognized Indian Tribes or individual Indians.

inflow—Water flowing into a lake or reservoir from a river and/or its tributaries, or water entering a river from tributaries.

irrigated area—The gross farm area upon which water is artificially applied for the production of crops, with no reduction for access roads, canals, or farm buildings.

irrigation—The controlled application of water to arable lands to supply water requirements not satisfied by rainfall.

juvenile—Young fish older than 1 year but not having reached reproductive age.

kilowatt-hour (kWh)—One thousand watt-hours of electrical energy.

land cover type—A classification system to describe vegetation and other habitat types (such as cottonwood willow, honey mesquite, and marsh).

landscape character—Overall visual appearance of a given landscape based on the form, line, color, and texture associated with the landscape's vegetation, landforms/water, and human-made modifications. These factors give the area a distinctive quality that distinguishes it from its immediate surroundings.

Las Vegas Valley—The topographic basin containing the city of Las Vegas, the city of North Las Vegas, the city of Henderson, and certain unincorporated townships of Clark County.

Las Vegas Wash—The natural drainage channel for the entire Las Vegas Valley. It is dominated by wastewater flows from the city of Las Vegas, Clark County Sanitation District, and city of Henderson wastewater treatment plants. It terminates in the Las Vegas Bay of Lake Mead.

Law of the River—As applied to the Colorado River, a body of documents the Secretary uses to carry out the responsibility to manage the mainstream waters of the Lower Basin pursuant to applicable federal law. The Secretary is vested with this responsibility. This collective set of documents comprising numerous operating criteria, regulations, and administrative decisions included in federal and state statues, interstate compacts, court decisions and decrees, an international treaty, and contracts with the Secretary apportions the Colorado River waters and regulates the use and management of the Colorado River among the seven Basin States and Mexico.

lead agency—An agency initiating and overseeing the preparation of an EIS. For this SEIS, Reclamation is the lead agency for compliance with NEPA.

Lee Ferry Compact Point—Identified the reference point that marks the division between the two subbasins—the Upper Basin and the Lower Basin—created by the division of the Colorado River Basin in the Colorado River Compact of 1922. This reference point is in the mainstream Colorado River in Arizona, 1 mile below the confluence of the Colorado River with the Paria River.

Lees Ferry Gaging Station—The site of the United States Geological Survey (USGS) stream gage (Lees Ferry Gaging Station) in Arizona on the Colorado River upstream of its confluence with the Paria River, downstream of Glen Canyon Dam. Also, the location of Colorado River ferry crossings (1873 to 1928).

limnology—Scientific study of physical characteristics and the biology of lakes, ponds, and streams.

load—Amount of electrical power or energy delivered or required at a given point.

Lower Basin (States)—Those parts of the states of Arizona, California, Nevada, New Mexico, and Utah within and from which waters drain naturally into the Colorado River below the Lee Ferry Compact Point in Arizona. The Colorado River Compact of 1922 divided the Colorado River system into two subbasins: the Upper Basin and the Lower Basin. *See also* Lee Ferry Compact Point.

Lower Division (States)—Arizona, Nevada, and California. The Colorado River Compact of 1922 divided the seven Colorado River Basin states into two groups: Upper Division States and Lower Division States. The Lower Division States are Arizona, Nevada, and California. *See also* Basin States.

magnitude—A number characteristic of a quantity and forming a basis for comparison with similar quantities, such as flows.

mean monthly flow—Average flow for the month, usually expressed in cubic feet per second.

mean sea level (msl)—The average height of the surface of the oceans and seas measured throughout all stages of the tidal cycle, determined from hourly readings of tidal height, and

computed over a long (usually 19-year) period. It is used as a datum plane (that is, it serves as the reference surface from which elevations and depths are measured).

median—Middle value in a distribution, above and below which lie an equal number of values.

megawatt (MW)—One million watts of electrical power (capacity).

megawatt-hour (MWh)—One million watt-hours of electrical energy.

Mesozoic era—The second-to-last era of earth's geological history, lasting from about 252 to 66 million years ago, comprising the Triassic, Jurassic, and Cretaceous periods.

metalimnion—Thermal layering of water in lakes and streams. *See also* stratification.

milligram per liter (mg/L)—Equivalent to one part per million.

National Environmental Policy Act of 1969, as amended (NEPA)—Law requiring federal agencies to integrate environmental values into their decision-making processes by considering the environmental impacts of their proposed actions and reasonable alternatives to those actions. To meet this requirement, federal agencies prepare a detailed statement known as an environmental impact statement, or EIS.

National Register of Historic Places (NRHP)—The Nation's official list of cultural resources worthy of preservation. Authorized under the National Historic Preservation Act of 1966, the NRHP is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect our historic and archaeological resources. Properties listed on the NRHP include districts, sites, buildings, structures, and objects that are significant in American history, architecture, archaeology, engineering, and culture.

natural flow—The flow of any stream un-depleted by human activities.

non-system water—Waters originating from outside the Colorado River system.

normal condition—When the Secretary has determined that there is available for annual release 7.5 million acre-feet (maf) to satisfy consumptive use in the Lower Division States pursuant to Article II(B)(1) of the Consolidated Decree.

oligotrophic—A body of water characterized by low dissolved plant nutrient and organic matter, and rich in oxygen at all depths.

Paleontological resources—Any fossilized remains, traces, or imprints of organisms preserved in or on the earth's crust.

Paleozoic era (541–252 million years ago)—Means ancient life. The oldest animals on earth appeared just before the start of this era.

Pangea—A supercontinent that existed from about 300 to 200 million years ago and included most of the continental crust of the earth.

peak flow—Maximum instantaneous flow in a specified period of time.

peak load—Maximum electrical demand in a stated period of time.

penstock—Conduit pipe used to convey water from the reservoir through the dam under pressure to the turbines of a hydroelectric plant.

percentile—A statistical term. A descriptive measure that splits ranked data into 100 parts, or hundredths. For example, the 10th percentile is the value that splits the data in such a way that 10 percent of the values are less than or equal to the 10th percentile.

piscivorous—Habitually feeding on fish.

PM_{10} (PM10)—Particulate matter (PM) (dust particles) standard that includes particles with a diameter of 10 micrometers or less.

power—Electrical capacity generated, transferred, or used.

Present Perfected Right (PPR)—Many Colorado River water rights that originated as "perfected rights" specified in the 1964 United States Supreme Court Decree in the case of *Arizona v. California.* PPRs are the highest-priority Colorado River water rights that the 1964 Decree defines as those perfected rights existing on June 25, 1929 (the effective date of the Boulder Canyon Project Act of 1928).

priority—A ranking with respect to diversions of water relative to other water users.

probability—In this SEIS, the relative frequency with which a range of modeled values occurs. For example, the probability of Lake Mead's elevation exceeding 1,180 feet msl in June 2005 is equal to the number of modeled elevations greater than 1,180 feet msl in June 2005, divided by the total number of modeled elevations in June 2005.

public involvement—Process of obtaining citizen input into each stage of development of planning documents. Required as a major input into any EIS.

Quaternary period—A geologic time period that encompasses the most recent 2.6 million years, including the present day.

ramp rate—The rate of change in instantaneous output from a powerplant. The ramp rate is established to prevent undesirable effects due to rapid changes in loading or, in the case of hydroelectric plants, discharge.

rated head—Water depth for which a hydroelectric generator and turbines were designed.

reach—A specified segment of a river, stream, channel, or other water conveyance facility.

recruitment—Survival of young plants and animals from birth to a life stage less vulnerable to environmental change.

reregulating reservoir—A reservoir for reducing diurnal fluctuations resulting from the operation of an upstream reservoir for power production.

resampling—The digital process of changing the sample rate or dimensions of sampled data (for example, digital imagery or audio) by temporarily or areally analyzing and sampling the original data.

reserved water—In the case of Indian reservations, rights based on the doctrine of Indian reserved rights; in the case of federal establishments other than Indian reservations, a federal reservation of water for use on property under federal jurisdiction.

reservoir—A pond, lake, or basin, either natural or artificial, for the storage, regulation, and control of water.

return flow—The portion of water previously diverted from a river or stream and subsequently returned to that river or stream; it is available for consumptive use by others.

return flow credit—In the accounting of consumptive use in the Lower Basin, Colorado River water that is returned to the river and is available for consumptive use by others in the year in which it was diverted is credited against a water user's total diversions.

riffle—A stretch of choppy water caused by an underlying rock shoal or sandbar.

riparian—Of, on, or pertaining to the bank of a river, pond, or lake.

river mile (RM)—Numbered along the Colorado River from south to north starting with RM 0.0 at the Southerly International Boundary (SIB) with Mexico. Dam locations are noted at their respective river miles.

river outlet works—Dam structures that conduct water from the reservoir to the river without passing through a powerplant; also referred to as jet tubes, bypass tubes, or outlet works.

river stage—Water surface elevation of a river above a datum.

RiverWare™—A commercial river system simulation computer program that was configured to simulate operation of the Colorado River for this SEIS.

runoff—That part of the precipitation that appears in surface streams. It is the same as streamflow unaffected by artificial diversions, storage, or other works of humans in or on the stream channels.

sacred site—A specific location identified by a Native American Tribe as sacred for its religious significance to, or ceremonial use by, a Native American religion.

salinity—A term used to refer to the dissolved minerals in water; also referred to as total dissolved solids (TDS). *See also* total dissolved solids.

sandbar—A long, narrow deposition of sediment within a river.

Secretary—The Secretary of the Department of the Interior, and duly appointed successors, representatives, and others with properly delegated authority.

Section 10(a)(1)(B) permit—The section of the ESA that authorizes the Service to issue nonfederal entities a permit for the incidental take of endangered and threatened wildlife species. This permit allows the nonfederal entity to proceed with an activity that is legal in all other respects, but that results in the "incidental to, and not the purpose of, the carrying out of an otherwise lawful activity." *See also* take.

sediment—Unconsolidated solid material that comes from weathering of rock and is carried by, suspended in, or deposited by water or wind.

sediment load—Mass of sediment passing through a stream.

seepage—Relatively slow movement of water through a medium, such as sand.

SEIS conservation— Part of the specific proposal submitted by the Lower Basin states in the Proposed Action. It has a specific amount as part of that action – 3.0 maf of SEIS conservation by the end of 2026, with at least 1.5 maf of that conserved in 2023 and 2024.

shortage condition—When the Secretary has determined that there is available for annual release less than 7.5 maf to satisfy consumptive use in the Lower Division States pursuant to Article II(B)(3) of the Consolidated Decree.

spawn—To lay eggs, especially fish.

spills—Water releases from a dam in excess of powerplant capacity.

spillway—Overflow facility at a dam, usually consisting of a sill at the full-reservoir elevation.

spinning reserves—Available capacity of generating facilities synchronized to the interconnected electric system so that it can be called upon for immediate use in response to system problems or sudden load changes.

stage—Reservoir elevation.

standards—A means established by authority as a rule for the measure of quality, such as cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water.

storage—Water artificially impounded in surface or underground reservoirs for future use. Water naturally detained in a drainage basin, such as groundwater, channel storage, and depression storage. The term "drainage basin storage" or simply "basin storage" is sometimes used to refer collectively to the amount of water in natural storage in a drainage basin. *See also* conservation storage and dead storage.

stormwater—Consists of water that originates from precipitation, such as heavy rain or snow.

stratification—Thermal layering of water in lakes and streams. Lakes usually have three zones of varying temperature: (1) epilimnion—top layer with essentially uniform warmer temperature, (2) metalimnion—middle layer of rapid temperature decrease with depth, and (3) hypolimnion—bottom layer with essentially uniform colder temperatures.

streamflow—The discharge that occurs in a natural channel. Although the term "discharge" can be applied to the flow of a canal, the word streamflow uniquely describes the discharge in a surface stream course. The term "streamflow" is more general than runoff, as streamflow may be applied to discharge whether it is affected by diversion or regulation.

suspended load—Sediment that is supported by the upward components of turbulence in a stream and that stays in suspension for an appreciable length of time.

surplus condition—When the Secretary has determined that there is available for annual release more than 7.5 maf to satisfy consumptive use in the Lower Division States pursuant to Article II(B)(2) of the Consolidated Decree.

system conservation— a voluntary reduction of Consumptive Use of Colorado River water that can be estimated or measured.

system storage—The total volume of water available in the Colorado River Basin at a specific point in time.

system water—Waters originating from the Colorado River system.

tail water—Water immediately downstream of the outlet from a dam or hydroelectric powerplant where the water is more similar to that in the reservoir than farther downstream.

take—As defined by the ESA, a means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct (16 United States Code 1531[18]).

thermocline—The zone of maximum change in temperature in a waterbody, separating upper (epilimnetic) from lower (hypolimnetic) zones.

threatened species—A species or subspecies that is likely to become endangered in the foreseeable future.

total dissolved solids (TDS)—Dissolved materials in the water, including ions such as potassium, sodium, chloride, carbonate, sulfate, calcium, and magnesium. In many instances, the term "TDS" is used to reflect salinity, since these ions are typically in the form of salts.

traces —Multiple time series of forecasted streamflow used in hydrological modeling. Multiple traces are sometimes referred to as an ensemble.

traditional cultural place—A type of historic property that is rooted in a community's history and important to that community's cultural identity.

tributary—River or stream flowing into a larger river or stream.

turbidity—Cloudiness of water, measured by how deeply light can penetrate into the water column from the surface.

turbine—A rotary mechanical device that uses water flow to turn and convert it into useful energy.

Upper Basin (States)—Those parts of the states of Arizona, Colorado, New Mexico, Utah, and Wyoming within and from which waters drain naturally into the Colorado River above the Lee Ferry Compact Point in Arizona. The Colorado River Compact of 1922 divided the Colorado River system into two subbasins: the Upper Basin and the Lower Basin. *See also* Lee Ferry Compact Point.

Upper Colorado River Commission—Commission established by the Upper Colorado River Compact of appointed members from the Upper Division States whose purpose is to secure the storage of water for beneficial consumptive use in the Upper Basin.

Upper Division (States)—Colorado, New Mexico, Utah, and Wyoming. The Colorado River Compact of 1922 divided the seven Colorado River Basin states into two groups: Upper Division States and Lower Division States. The Upper Division States are Colorado, New Mexico, Utah, and Wyoming. *See also* Basin States.

Visual resources—Physical features that make up the visible landscape (features such as land, water, vegetation, topography, and human-made features such as buildings, roads, utilities, and structures) as well as the response of viewers to those features.

Water Year—That period of 12 months ending September 30 of each year.

Waters of the United States—In accordance with the Clean Water Act, waters of the United States include (1) all waters that may be susceptible to use in interstate or foreign commerce; (2) all interstate waters, including interstate wetlands; (3) all other waters, such as intrastate lakes, rivers, streams (including intermittent streams), mud flats, sand flats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation, or destruction of which could affect interstate or foreign commerce, including any such waters; (4) all impoundments of waters otherwise defined as waters of the United States; (5) tributaries of waters identified in this SEIS; (6) the territorial seas; and (7) wetlands adjacent to waters (other than waters that are themselves wetlands) identified in this SEIS.

watershed—The drainage area upstream of a specified point on a stream.

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Appendix A

Overview of Colorado River Operations

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Appendix A. Overview of Colorado River Operations

A.1 Introduction

This appendix summarizes Colorado River operations, including the distribution of Colorado River water under the Law of the River, and the reservoirs and diversion facilities through which the water supply is administered.

A.2 Apportionment of Water Supply

This section summarizes the Law of the River, Colorado River apportionments of the Basin States, and the allotment to Mexico pursuant to the 1944 Water Treaty.

A.2.1 The Law of the River

The Secretary is vested with the responsibility to manage the mainstream waters of the Colorado River Basin pursuant to applicable federal law. This responsibility is carried out consistent with a body of documents commonly referred to as the Law of the River. The Law of the River comprises numerous operating criteria, regulations, and administrative decisions included in federal and state statutes, interstate compacts, court decisions and decrees, an international treaty, and contracts with the Secretary. Documents that are generally considered part of the Law of the River include, but are not limited to, those listed in **Table A-1**, below.

Table A-1
Selected Documents Included in the Law of the River

▪ The River and Harbor Act of March 3, 1899 ▪ The Reclamation Act of June 17, 1902 ▪ Reclamation of Indian Lands in Yuma, Colorado River and Pyramid Lake Indian Reservations Act of April 21, 1904 ▪ Yuma Project authorized by the Secretary of the Interior on May 10, 1904, pursuant to Section 4 of the Reclamation Act of June 17, 1902 ▪ Warren Act of February 21, 1910 ▪ Protection of Property Along the Colorado River Act of June 25, 1910 ▪ Patents and Water-Right Certificates Acts of August 9, 1912, and August 26, 1912	▪ The Colorado River Storage Project Act of April 11, 1956 ▪ The Water Supply Act of July 3, 1958 ▪ The Boulder City Act of September 2, 1958 ▪ Report of the Special Master, Simon H. Rifkind, *Arizona v. California*, et al., December 5, 1960 ▪ The Consolidated Decree entered by the United States Supreme Court in the case of *Arizona v. California*, 547 US 150 (2006) (Consolidated Decree) ▪ International Flood Control Measures, Lower Colorado River Act of August 10, 1964

Table A-1
Selected Documents Included in the Law of the River

- Yuma Auxiliary Project Act of January 25, 1917
- Availability of Money for Yuma Auxiliary Project Act of February 11, 1918
- Sale of Water for Miscellaneous Purposes Act of February 25, 1920
- Federal Power Act of June 10, 1920
- The Colorado River Compact of November 24, 1922
- The Colorado River Front Work and Levee System Acts of March 3, 1925, and January 21,1927–June 28, 1946
- The Boulder Canyon Project Act of December 21, 1928 (BCPA)
- The California Limitation Act of March 4, 1929
- The California Seven Party Agreement of August 18, 1931
- The Parker and Grand Coulee Dams Authorization of August 30, 1935
- The Parker Dam Power Project Appropriation Act of May 2, 1939
- The Reclamation Project Act of August 4, 1939
- The Boulder Canyon Project Adjustment Act of July 19, 1940
- The Flood Control Act of December 22, 1944
- Treaty between the United States and Mexico Relating to the Utilization of the Waters of the Colorado and Tijuana Rivers and of the Rio Grande of February 3, 1944 (1944 Water Treaty)
- Gila Project Act of July 30, 1947
- The Upper Colorado River Basin Compact of October 11, 1948
- The Consolidated Parker Dam Power Project and Davis Dam Project Act of May 28, 1954
- The Palo Verde Diversion Dam Act of August 31, 1954
- Change Boundaries, Yuma Auxiliary Project Act of February 15, 1956
- Southern Nevada (Robert B. Griffith) Water Project Act of October 22, 1965
- The Colorado River Basin Project Act of September 30, 1968
- Criteria for the Coordinated Long-Range Operation of Colorado River Reservoirs, June 8, 1970, amended March 21, 2005
- Supplemental Irrigation Facilities, Yuma Division Act of September 25, 1970
- 43 CFR 417, Lower Basin Water Conservation Measures, September 7, 1972
- Minute 218, March 22, 1965; Minute 241, July 14, 1972 (replaced Minute 218); Minute 242, August 30, 1973 (replaced Minute 241); Minute 306, December 12, 2000; Minute 317, June 27, 2010; and Minute 323, September 21, 2017, of the 1944 Water Treaty
- The Colorado River Basin Salinity Control Act of June 24, 1974
- The Hoover Power Plant Act of August 17, 1984
- Numerous Colorado River Water Delivery and Project Repayment Contracts with the States of Arizona and Nevada, cities, water districts, and individuals
- Hoover and Parker-Davis Power Marketing Contracts
- The Reclamation States Emergency Drought Relief Act of 1991
- The Grand Canyon Protection Act of October 30, 1992
- Operation of Glen Canyon Dam, Record of Decision (1996)
- Interim Surplus Guidelines Record of Decision, January 17, 2001 (66 *Federal Register* 7772)
- Interim 602(a) Storage Guideline, May 19, 2004 (69 *Federal Register* 28945)
- The Colorado River Water Delivery Agreement of October 10, 2003 (69 *Federal Register* 12202)
- Glen Canyon Dam Long-Term Experimental and Management Plan – Final EIS and ROD, December 2016 (Reclamation 2016)
- Colorado River Basin Drought Contingency Plans (Reclamation 2019)

Among other provisions of applicable federal law, NEPA and the ESA, as amended, provide a statutory overlay on certain actions taken by the Secretary. For example, as noted in **Chapter 1**, preparation of this SEIS has been undertaken pursuant to NEPA.

A.2.2 Apportionment to the Basin States

The initial apportionment of water from the Colorado River was determined as part of the Colorado River Compact (1922), which divided the Colorado River system into two subbasins, the Upper Basin and the Lower Basin, and divided the seven Basin States into Upper Division States and Lower Division States (**Map A-1**).

The compact apportioned to the Lower Basin and the Upper Basin, in perpetuity, the exclusive beneficial consumptive use of 7.5 maf of water per year. In addition to this apportionment, Article III(b) of the compact gives the Lower Basin the right to increase its beneficial consumptive use by 1.0 maf per year. The compact also stipulates in Article III(d) that the Upper Division States will not cause the flow of the river at the Lee Ferry Compact Point to be depleted below an aggregate of 75 maf for any period of 10 consecutive years.

The compact, in Article VII, states that nothing in the compact shall be construed as affecting the obligations of the United States to Indian Tribes. While the rights of most Indian Tribes to Colorado River water were subsequently adjudicated, some Tribal rights remain unadjudicated. To the extent that Indian Tribes consumptively use water from the Colorado River, such uses are included in the apportionment of the appropriate Basin State.

Upper Division State Apportionments. The Upper Colorado River Basin Compact of 1948 established the Upper Division State apportionments. These apportionments allocate the Upper Division States' consumptive use after deduction of up to 50,000 afy for Arizona as follows: Colorado, 51.75 percent; New Mexico, 11.25 percent; Utah, 23.00 percent; and Wyoming, 14.00 percent. The Upper Division State apportionments have not yet been fully developed.

Lower Division State Apportionments. Lower Division State apportionments were established by Congress in the BCPA and by the Secretary's water delivery contracts under the BCPA. These apportionments are Arizona (2.8 maf), California (4.4 maf), and Nevada (0.3 maf), totaling 7.5 maf, subject to annual increases or reductions pursuant to Secretarial determinations of a Surplus or a Shortage Condition. Under Article II(B)(2) of the Consolidated Decree, when the Secretary determines there is a Surplus Condition, 46 percent of the available water supply in excess of 7.5 maf may be apportioned for use in Arizona, 50 percent may be apportioned for use in California, and 4 percent may be apportioned for use in Nevada.

The Consolidated Decree confirms the apportionments to the Lower Division States established by the BCPA and guides the Secretary's operation of facilities, including Hoover Dam, on the lower Colorado River. If water apportioned for use in a Lower Division State is not consumed by that state in any year, the Secretary may release the unused water for use in another Lower Division State. Water that is stored off stream by a Lower Division State is accounted as consumptive use to the state that stored the water in the year it was stored.

All mainstream Colorado River waters apportioned to the Lower Basin, except for approximately 10,000 af remaining of Arizona's apportionment, have been fully allocated to specific entities and, except for certain federal establishments, placed under permanent water delivery contracts with the Secretary for irrigation or domestic use. Federal establishments with federal reserved rights established pursuant to Article II(D) of the Consolidated Decree are not required to have a contract with the Secretary; however, the water allocated to a federal establishment is included within the apportionment of the Lower Division State in which the federal establishment is located.

The highest-priority lower Colorado River water rights are PPRs, which the Consolidated Decree defines as those perfected rights existing on June 25, 1929, which is the BCPA's effective date. The Consolidated Decree also recognizes federal Indian reserved rights for the quantity of water necessary to irrigate all the practicably irrigable acreage on five Indian reservations along the lower Colorado River (the Chemehuevi Indian Tribe, Colorado River Indian Tribes, Fort Mojave Indian Tribe, Fort Yuma-Quechan Tribe, and Cocopah Indian Tribe). The Consolidated Decree defines the rights of Indian and other federal reservations to be federal establishment PPRs, and further prescribes a specific order in which federal establishment and other PPRs must be satisfied, generally by priority date without regard to state lines. In any year in which less than 7.5 maf of Colorado River water is available for consumptive use in the Lower Division States, PPRs will be satisfied first.

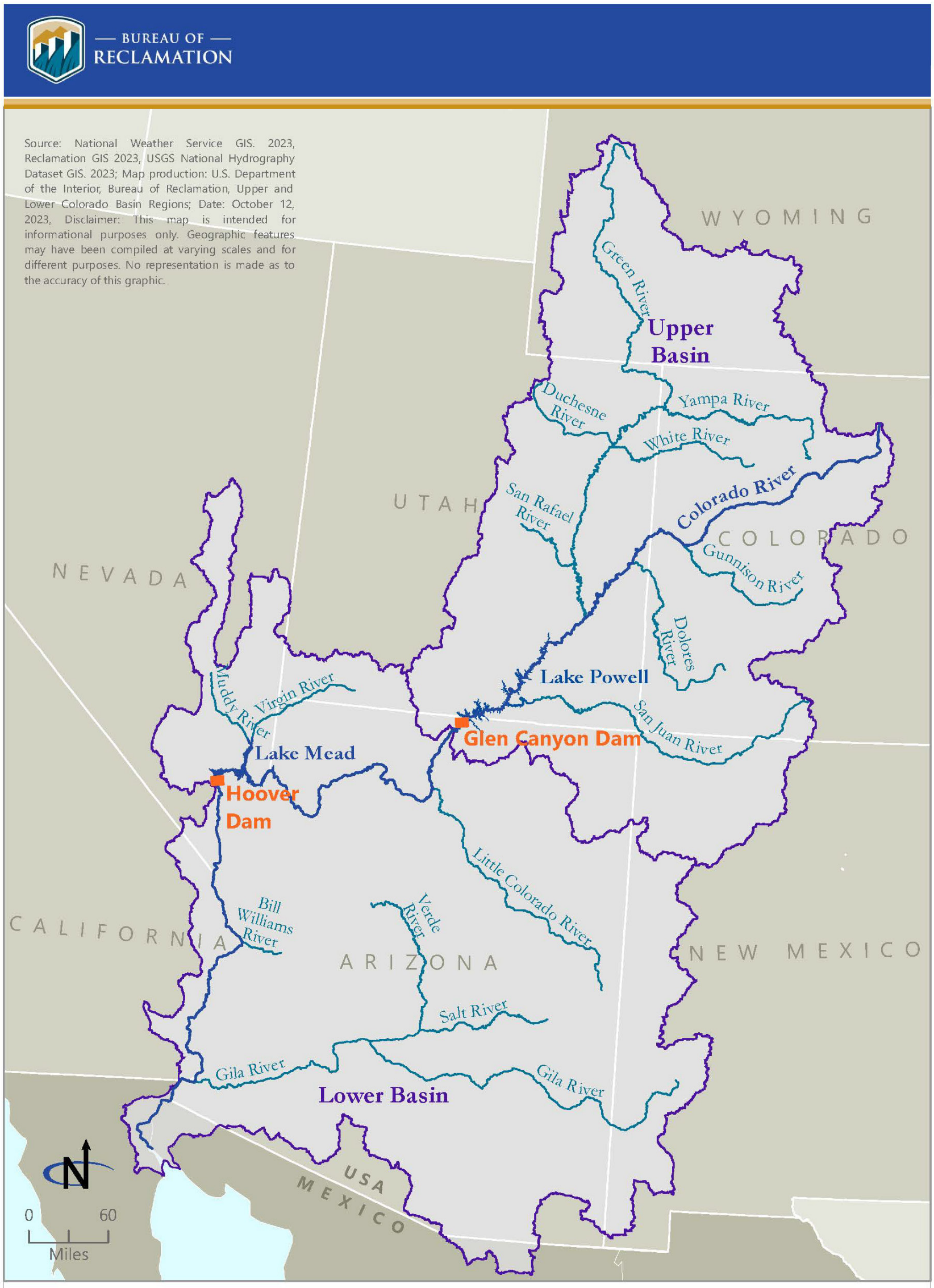
Waters available to a Lower Division State within its apportionment, but having a priority date later than June 25, 1929, have been allocated by the Secretary through execution of water delivery contracts to water users within that state, as required by Section 5 of the BCPA. The Lower Division States have separate intrastate priority systems in accordance with those contracts.

A.2.3 Allotment to Mexico (Pursuant to the 1944 Water Treaty)

Allocation of Colorado River water to Mexico is governed by the 1944 Water Treaty. To assess the potential effects of the alternatives in this SEIS, certain modeling assumptions (discussed in **Chapter 2**) are used that display projected water deliveries to Mexico. These assumptions include continued implementation of Minute 323 to the 1944 Water Treaty. Reclamation's modeling assumptions are not intended to constitute an interpretation or application of the 1944 Water Treaty or to represent current United States policy or a determination of future United States policy regarding deliveries to Mexico.

The United States will conduct all necessary and appropriate discussions regarding the Proposed Action and implementation of the 1944 Water Treaty with Mexico through the USIBWC in consultation with the Department of State.

Map A-1
Upper and Lower Division States of the Colorado River



Map A-1
Upper and Lower Division States of the Colorado River

- Colorado River
- Colorado River tributary
- Dam
- Colorado River Basin, Upper and Lower Basins

States in the Colorado River Basin (Wyoming, Colorado, Utah, and New Mexico are Upper Division states, and Arizona, California, and Nevada are Lower Division states)

While portions of northwestern Mexico are part of the Basin, these areas are not within the geographic scope of analysis for this SEIS. This SEIS does not address water deliveries to Mexico.

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A.3 Water Operations

A.3.1 Lake Powell and Lake Mead and the Diversion Facilities

The Colorado River system contains numerous reservoirs that provide an aggregate of approximately 60 maf of storage. Of these reservoirs, Lake Powell and Lake Mead constitute approximately 83 percent of this storage; Lake Powell provides 23.3 maf of this storage, and Lake Mead can store up to 26.2 maf.

A.3.2 Hydropower Generation

Reclamation is authorized by legislation to produce electric power at both Glen Canyon Dam and Hoover Dam through the Colorado River Storage Project Act of 1956 and the Boulder Canyon Project Act of 1940. While Reclamation is the federal agency authorized to produce power at the major Colorado River system dams, WAPA is the federal agency authorized to market and deliver this power. WAPA enters into electric service contracts on behalf of the United States with public and private utility systems for distribution of hydroelectric power produced at Reclamation facilities in excess of project demand.

A.3.3 Current Operational Guidelines

The following details the post-2007 Colorado River operational guidelines:

- Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead – Final EIS and ROD, November 2007 (Reclamation 2007)

  The 2007 Interim Guidelines are the specific interim guidelines for Lower Basin shortages and coordinated operations for Lake Powell and Lake Mead. These interim guidelines were intended to remain in effect for determinations to be made through 2025 regarding water supply and reservoir operating decisions through 2026. They also would provide guidance each year in development of the AOP. The 2007 Interim Guidelines considered four operational elements that collectively are designed to address the purpose and need for the proposed federal action. The 2007 Interim Guidelines were used by the Secretary to:
  - determine those circumstances under which the Secretary would reduce the annual amount of water available for consumptive use from Lake Mead to the Lower Division States (Arizona, California, and Nevada) below 7.5 maf (a "Shortage") pursuant to Article II(B)(3) of the Consolidated Decree
  - define the coordinated operation of Lake Powell and Lake Mead to provide improved operation of these two reservoirs, particularly under low reservoir conditions
  - allow for the storage and delivery, pursuant to applicable federal law, of conserved Colorado River system and nonsystem water in Lake Mead to increase the flexibility of meeting water use needs from Lake Mead, particularly under drought and low reservoir conditions
  - determine those conditions under which the Secretary may declare the availability of surplus water for use within the Lower Division States

- Glen Canyon Dam Long-Term Experimental and Management Plan – Final EIS and ROD, December 2016 (Reclamation 2016)

  Reclamation and the NPS developed and implemented the LTEMP for operations of Glen Canyon Dam, the largest unit of the CRSP. The LTEMP provides a framework for adaptively managing Glen Canyon Dam's operations through 2036, consistent with the GCPA and other provisions of applicable federal law. The LTEMP determines the specific options for dam operations, non-flow actions, and appropriate experimental and management actions that meet the GCPA's requirements and minimize impacts on resources within the area affected by dam operations, commonly referred to as the Colorado River Ecosystem, including those of importance to American Indian Tribes.

- Colorado River Basin Drought Contingency Plans

  In 2019, the DCPs were signed pursuant to congressional direction provided in Public Law 116-14. The DCPs outline strategies to address the ongoing historic drought in the Colorado River Basin. The Upper Basin DCP is designed to reduce the risk of reaching critical elevations at Lake Powell and to help assure continued compliance with the 1922 Colorado River Compact.

  The DROA is one element of the Upper Basin DCP. The DROA identifies a process to temporarily move water stored in the CRSP Initial Units above Lake Powell—Blue Mesa Reservoir (a component of the Aspinall Unit), Flaming Gorge, and Navajo—to Lake Powell when Lake Powell is projected to approach elevation 3,525 feet, which was identified in the DROA as the target elevation. This elevation provides a 35-foot buffer above the minimum power pool of 3,490 feet. Maintaining an elevation above 3,525 feet will help ensure compliance with interstate water compact obligations, maintain the ability to generate hydropower at Glen Canyon Dam, and minimize adverse effects on resources and infrastructure in the Upper Basin.

  Pursuant to the DROA, Reclamation worked with the Upper Division States on a DROA in 2022 with the goal of implementing operational measures to augment water deliveries from the three upstream CRSP Initial Units (that is, Aspinall, Flaming George, and Navajo) to prop up Lake Powell. Reclamation continues to closely monitor hydrologic conditions and projections to identify appropriate upstream release volumes to maintain Lake Powell's water level above the target elevation.[1]

[1] As of December 31, 2023, all previous DROA releases from Blue Mesa Reservoir have been recovered and approximately 95,000 af of previous DROA releases from Flaming Gorge Reservoir remain to be recovered. Full recovery at Flaming Gorge is projected by the end of February 2024.

Appendix B

Hydrology Analysis for the No Action Alternative, Action Alternatives 1 and 2, and the Proposed Action

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Appendix B. Hydrology Analysis for the No Action Alternative, Action Alternatives 1 and 2, and the Proposed Action

B.1 Introduction

Action Alternatives 1 and 2 were analyzed in the original Draft SEIS issued April 14, 2023, which modeled changes to operations for both Glen Canyon Dam and Hoover Dam as developed by Reclamation. As described in **Chapter 2**, Action Alternatives 1 and 2 were eliminated from detailed analysis in the revised Draft SEIS and this Final SEIS due to updated hydrology and the addition of the Proposed Action, which provides a similar risk reduction compared with Action Alternatives 1 and 2. This appendix provides a detailed hydrologic analysis of the No Action Alternative, Action Alternatives 1 and 2, and the Proposed Action; this analysis was used to inform Reclamation's decision to eliminate Action Alternatives 1 and 2 from detailed analysis.

Reclamation updated the modeling assumptions for Action Alternatives 1 and 2 since publication of the original Draft SEIS due to updated hydrology (see the **Dear Reader Letter**); these assumptions are summarized in **Section B.2.1**. This analysis does not cover the breadth of resources or geographic locations included in **Chapter 3** of this SEIS; instead, it focuses on higher-level comparisons with respect to hydrologic resources and water deliveries, which are the primary categories from which relative effects on other resources can be inferred.

B.2 Modeling Approach

This section summarizes the assumptions that Reclamation used in the hydrologic modeling and the metrics used to analyze the alternatives. Future Colorado River system conditions during the analysis period for all alternatives were simulated using the June 2023 CRMMS. Details on the modeling assumptions used for the comparative analysis are found in **Sections B.3.1, B.3.2**, and **B.3.3**. **Section B.3.4** summarizes the metrics used to compare the submitted alternatives.

B.2.1 Modeling Assumptions

The No Action Alternative and the Proposed Action are described in **Chapter 2** with detailed modeling assumptions in **Section 3.3.4** and **Appendix D,** CRMMS Model Documentation.

The following section summarizes the assumptions for Action Alternatives 1 and 2, which have been updated since the original Draft SEIS. In the revised Draft SEIS and this Final SEIS, no additional shortages are modeled in 2024, and shortages for Action Alternatives 1 and 2 are the same in 2025 and 2026, with a maximum total shortage of 2.083 maf. Additionally, no potential DROA

contributions are modeled in the revised Draft SEIS or this Final SEIS. Assumptions common to all alternatives that were summarized in **Section 3.3.4** also apply to Action Alternatives 1 and 2.

The hydrologies used in this appendix are derived from the June 2023 Colorado Basin River Forecast Center's ESP Upper Basin forecast and associated Lower Basin intervening flows. Three sets of ESPs are used in the SEIS modeling:

- 100 percent ESP: There is no adjustment to the streamflow forecasts.
- 90 percent ESP: Streamflow forecasts are reduced by 10 percent.
- 80 percent ESP: Streamflow forecasts are reduced by 20 percent.

Detailed hydrologic inputs, initial conditions, and other modeling assumptions not described in the following sections are consistent with the assumptions included for the No Action Alternative and Proposed Action (see **Appendix D**).

Assumptions for Action Alternative 1

Assumptions for Action Alternative 1 are summarized below. Detailed modeling assumptions for CRMMS can be found in **Attachment B-1.**

- Only operational changes for Lake Powell and Lake Mead, as per Section 2.D, Section 6.C, and Section 6.D of the 2007 Interim Guidelines, were considered; otherwise, operations for Lake Powell and Lake Mead are consistent with operations under the No Action Alternative.
- The Mid-Elevation Release Tier and Lower Elevation Balancing Tier in Lake Powell are replaced with the Lower Elevation Release Tier in operating years 2025 and 2026.
- The new Lower Elevation Release Tier in Lake Powell is operational if the elevation in Lake Powell at the end of the year is below 3,575 feet. Releases will be between 6.0 and 8.23 maf depending on the elevation of Lake Powell and the hydrology. Releases may be further reduced to prevent Lake Powell from dropping below 3,500 feet.
- Deliveries to the Lower Division States during Shortage Condition Years 2025 and 2026 (up to 2.083 maf) are described in **Section B.2.3**.
- Shortage reductions in excess of the 2007 ROD shortages and 2019 DCP contributions are distributed to the Lower Basin based on priority.
- DCP contributions and ICS assumptions are consistent with the official June 2023 CRMMS simulation.
- System conservation volumes in 2023 and 2024 are consistent with the official June 2023 CRMMS simulation. In 2025 and 2026, system conservation volumes are set to zero.

Assumptions for Action Alternative 2

Assumptions for Action Alternative 2 are summarized below. Detailed modeling assumptions for CRMMS can be found in **Attachment B-1**.

- Only operational changes for Lake Powell and Lake Mead, as per Section 2.D, Section 6.C, and Section 6.D of the 2007 Interim Guidelines, were considered; otherwise, operations for Lake Powell and Lake Mead are consistent with operations under the No Action Alternative.

- The Mid-Elevation Release Tier and Lower Elevation Balancing Tier in Lake Powell are replaced with the Lower Elevation Release Tier, which is operated the same way as in Action Alternative 1.
- Deliveries to the Lower Division States during Shortage Condition Years 2025 and 2026 (up to 2.083 maf) are described in **Section B.2.3**.
- Shortage reductions in excess of the 2007 ROD shortages and 2019 DCP contributions are distributed in the same percentage across all Lower Basin water users at the specified Lake Mead elevations. The distribution of reductions is based on each user's consumptively used water in 2021.
- DCP contributions and ICS assumptions are consistent with the official June 2023 CRMMS simulation.
- System conservation volumes in 2023 and 2024 are consistent with the official June 2023 CRMMS simulation. In 2025 and 2026, system conservation volumes are set to zero.

B.2.2 Coordinated Reservoir Operations

Under Action Alternatives 1 and 2, the annual Lake Powell release is based on the volume of water in storage or the corresponding elevation of Lake Powell and Lake Mead, as described in the Operational Tiers below (see **Table B-1**). The Equalization and Upper Elevation Balancing Tiers are the same as under the No Action Alternative. In operating years 2025 and 2026, the Mid-Elevation Release Tier and Lower Elevation Balancing Tier are combined into a single Lower Elevation Release Tier, and a protection level is also included. The applicable Operational Tier is based on the August 24-Month Study projections of the January 1 system storage and reservoir water surface elevations for the following operating year.

Hourly, daily, and monthly releases from Lake Powell for coordinated operations would be consistent with the parameters of the ROD for the LTEMP FEIS (Reclamation and NPS 2016). Monthly releases from Glen Canyon Dam would be distributed proportionally across months for annual releases below 7.0 maf (see **Figure B-1** for monthly distributions in a year when the annual release is 8.23 maf). If annual flows were adjusted mid-year, they would be distributed to meet the goals of LTEMP, including the potential distribution across monthly or experimental flow patterns, and including the unique resource considerations specific to any mid-year annual adjustments.

Hourly and daily releases would follow LTEMP parameters, so long as sufficient water is available from the annual release. If sufficient water is not available from the annual release to meet hourly and daily LTEMP release parameters, hourly and daily releases would follow the base operation daily and nightly minimum flows (8,000 cfs and 5,000 cfs, respectively), for as long as possible. If sufficient water is not available from the annual release to support the base operation nightly minimum flow of 5,000 cfs, hourly and daily releases would be consistent with the run of the river[1] to match Lake Powell inflows consistent with protecting an elevation of 3,500 feet at Lake Powell.

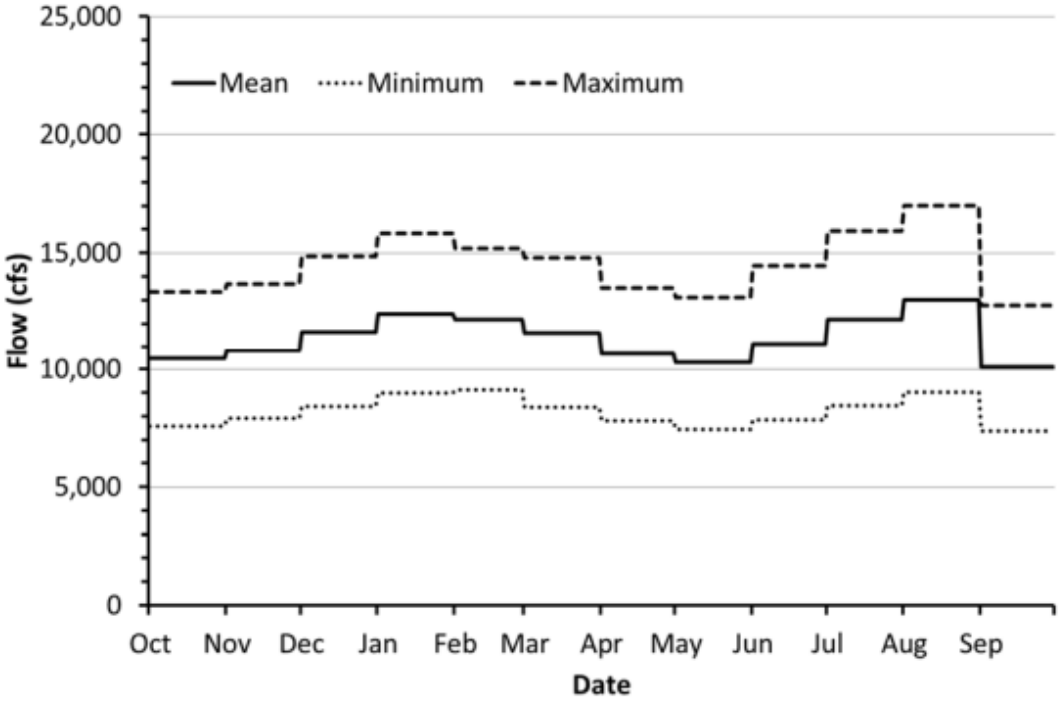
[1] In general, "run of the river" means the inflow equals the outflow, adjusted for operational considerations, such as evaporation, seepage, and release capacity.

Table B-1
Lake Powell Operational Tiers, Action Alternatives 1 and 2

Lake Powell Operational Tiers (subject to April adjustments or mid-year review modifications)		
Lake Powell Elevation (feet)	**Lake Powell Operational Tier**	**Lake Powell Active Storage*** (maf)
3,700		**23.31**
	Equalization Tier Equalize, avoid spills, or release 8.23 maf	
3,636–3,666 (see Table 2.3-1 in the 2007 FEIS)	**Upper Elevation Balancing Tier** Release 8.23 maf; if Lake Mead <1,075 feet, balance contents with a minimum/maximum release of 7.0/9.0 maf	**14.65–18.36** (2008–2026)
3,575		**8.90**
	Lower Elevation Release Tier Set initial release of 6.0 maf; adjust releases based on the April Lake Powell end-of-water-year elevation projection: ≥3,575 feet, release 8.23 maf <3,575 feet AND ≥3,550 feet, release 7.48 maf <3,550 feet AND ≥3,525 feet, release 7.0 maf <3,525 feet AND ≥3,500 feet, maintain release of 6.0 maf <3,500 feet, reduce releases (gains equal losses) such that Lake Powell ends the operating year at 3,500 feet	
3,500		**4.22**
	Protection Level <3,500 feet, in any month, reduce releases (gains equal losses) such that Lake Powell ends the operating year at 3,500 feet	
3,370		**0**

*Active storage values have been updated from 2007 based on the 2018 bathymetry.

Figure B-1
Mean, Minimum, and Maximum Monthly Flows under LTEMP in an 8.23-maf Year



Lower Elevation Release Tier

When the projected January 1 Lake Powell elevation is below 3,575 feet, an initial annual release in the amount of 6.0 maf would be set from Lake Powell. Reclamation may then adjust the annual release based on the April 24-Month Study, as outlined below:

- If the April 24-Month Study projects the end-of-water-year elevation to be at or above 3,575 feet, an adjustment would be made to release 8.23 maf from Lake Powell.
- If the April 24-Month Study projects the end-of-water-year elevation to be below 3,575 feet and at or above 3,550 feet, an adjustment would be made to release 7.48 maf from Lake Powell.
- If the April 24-Month Study projects the end-of-water-year elevation to be below 3,550 feet and at or above 3,525 feet, an adjustment would be made to release 7.0 maf from Lake Powell.
- If the April 24-Month Study projects the end-of-water-year elevation to be below 3,525 feet and at or above 3,500 feet, the release of 6.0 maf from Lake Powell would be maintained.
- If the April 24-Month Study projects the end-of-water-year elevation to be below 3,500 feet, the dam would be operated to maintain an elevation of at least 3,500 feet. Additionally, up to 6.0 maf would be released over the year with a goal of maintaining LTEMP minimum flows, subject to run-of-the-river conditions, operational constraints, and prudent operations as determined by Reclamation.

Protection Level

If, in any month, Lake Powell's elevation is below 3,500 feet, the Lake Powell release would be set to maintain or increase the elevation with a maximum release of 6.0 maf; the goal would be to maintain LTEMP minimum flows, subject to run-of-the-river conditions, operational constraints, and prudent operations as determined by Reclamation.

B.2.3 Shortage Sharing and Water Delivery Reduction Assumptions

A summary of the modeling assumptions for the alternatives, with respect to the reduction of deliveries due to shortage and DCP contributions to the Lower Division States, including the distribution of shortages by state for 2025 and 2026, is provided in **Table B-2**, **Table B-3**, and **Table B-4**. The distribution of shortages to individual users based on CRMMS modeling assumptions for Action Alternatives 1 and 2 can be found in **Attachment B-2**. System conservation volumes are summarized in **Attachment B-1**, **Table Attachment B-3**.

Table B-2 shows the Lower Basin shortages under the 2007 Interim Guidelines, contributions under the 2019 DCPs, and additional shortages modeled under Action Alternatives 1 and 2 in calendar years 2025 and 2026. **Table B-3** shows the assumptions for Action Alternative 1 regarding the breakdown of shortages and contributions by state, according to priority.

Table B-2
Lower Division States' Shortages and DCP Contributions, Action Alternatives 1 and 2 (2025–2026)*

Lake Mead Elevation (feet)	Existing 2007 ROD Shortages and 2019 DCP Contributions			Additional Shortages under Action Alternatives 1 and 2	
	2007 ROD Shortages (1,000 af)	2019 DCP Contributions (1,000 af)	Total (1,000 af)	Additional Shortages (1,000 af)	Total Shortages + Contributions (1,000 af)
1,090 – >1,075	0	200	200	200	**400**
1,075 – 1,050	333	200	533	533	**1,066**
<1,050 – >1,045	417	200	617	617	**1,234**
1,045 – >1,040	417	450	867	867	**1,734**
1,040 – >1,035	417	500	917	1,166	**2,083**
1,035 – >1,030	417	550	967	1,116	**2,083**
1,030 – 1,025	417	600	1,017	1,066	**2,083**
<1,025	500	600	1,100	983	**2,083**

* This table only shows combined Lower Division State shortage volumes and DCP contributions. In addition to the volumes shown in this table, the analysis for each alternative includes water delivery reductions to Mexico under low-elevation reservoir conditions and Mexico's savings that contribute to the Binational Water Scarcity Contingency Plan, in accordance with Minute 323 to the 1944 Water Treaty.

Table B-3
Lower Division States' Shortages and DCP Contributions by State, Action Alternative 1 (2025–2026)

Lake Mead Elevation (feet)	2007 ROD Shortage + 2019 DCP Contributions (1,000 af)				Action Alternative 1 Additional Shortage* (1,000 af)				Total Shortages + Contributions (1,000 af)			
	AZ	NV	CA	Total	AZ	NV	CA	Total	AZ	NV	CA	Total
1,090 – >1,075	192	8	0	200	192	8	0	200	384	16	0	400
1,075 – 1,050	512	21	0	533	511	22	0	533	1,023	43	0	1,066
<1,050 – >1,045	592	25	0	617	593	24	0	617	1,185	49	0	1,234
1,045 – >1,040	640	27	200	867	912	42	0	955	1,552	69	200**	1,734***
1,040 – >1,035	640	27	250	917	987	56	123	1,166	1,627	83	373	2,083
1,035 – >1,030	640	27	300	967	987	56	73	1,116	1,627	83	373	2,083
1,030 – 1,025	640	27	350	1,017	987	56	23	1,066	1,627	83	373	2,083
<1,025	720	30	350	1,100	907	53	23	983	1,627	83	373	2,083

*The additional shortage volumes decrease at elevation 1,025 feet because the shortages under the 2007 Interim Guidelines increase by the same amount. Therefore, the additional shortage amounts necessary to get to the 2.083 maf total are lower.
**In this elevation tier, the 2019 DCP contributions for California exceed what would be required under Action Alternative 1. As a result, no additional shortage is required in this elevation tier for California.
***Because the 2019 DCP contributions for California exceed the total shortage and contribution volume as modeled by the shortage allocation model, the sum of the three state totals exceeds the total shortage and contribution volume.

Figure B-2 shows a graphical view of Lower Basin shortages and contributions from the 2007 Interim Guidelines and the 2019 DCPs, plus additional shortages modeled under Action Alternative 1.

For Action Alterative 2, **Table B-4** displays the percentage of the additional shortage volumes at specified Lake Mead elevations and the distribution for each Lower Division State. As stated above, the total additional shortage volumes for the Lower Basin are the same under Action Alternative 2 as under Action Alternative 1. The additional shortage volumes identified in **Table B-2** for calendar years 2025 and 2026 would be achieved by a reduction of available Lower Basin annual consumptive use, distributed in the same percentage across all Lower Basin water users at the specified Lake Mead elevations. The distribution of reductions modeled for Action Alternative 2 is based on each user's consumptively used water in 2021, as reported in Reclamation's final Colorado River Accounting and Water Use Report: Arizona, California, and Nevada. This report was prepared pursuant to Article V of the Supreme Court's decree in *Arizona v. California* (as adjusted for conservation).

Figure B-2
Modeled Lower Basin Shortages and DCP Contributions, Action Alternatives 1 and 2

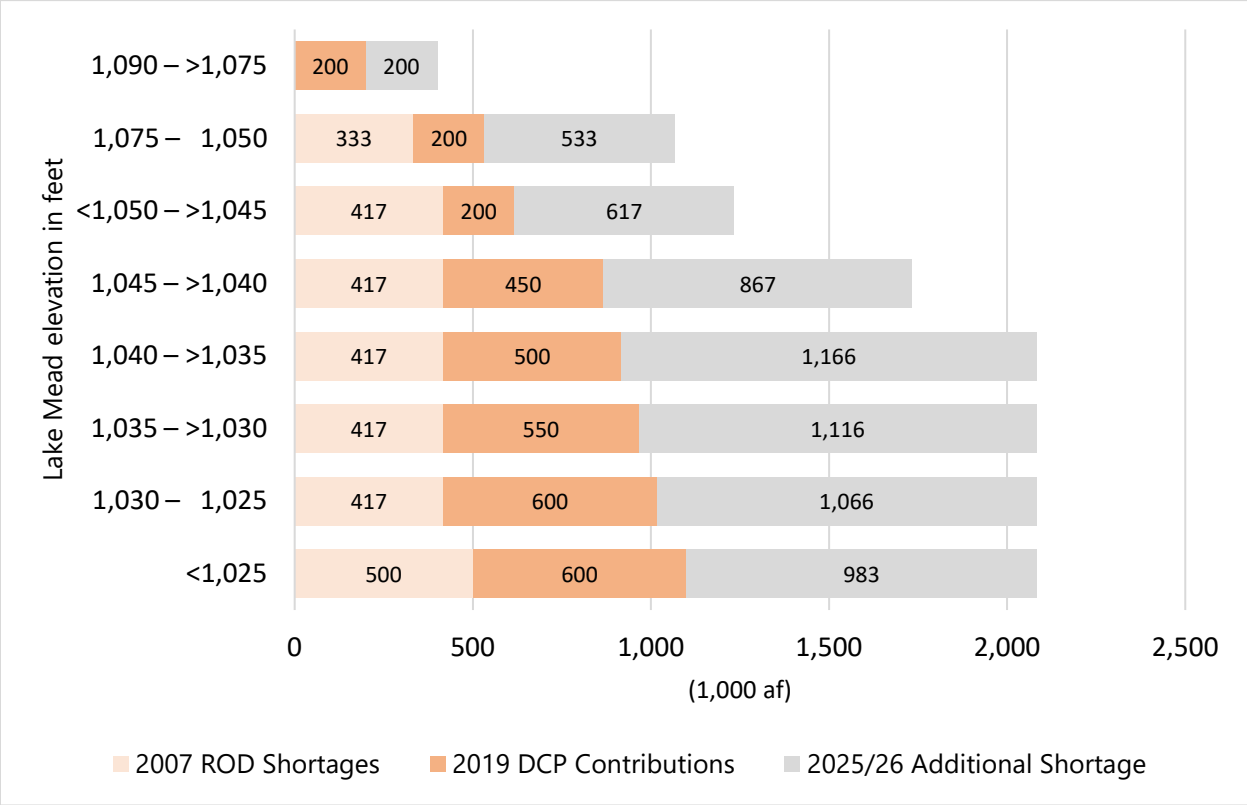


Table B-4
Lower Division States' Shortages and DCP Contributions by State, Action Alternative 2 (2025–2026)

Lake Mead Elevation (feet)	2007 ROD Shortages + 2019 DCP Contributions (1,000 af)				Additional Shortage* (1,000 af)					Total Shortage + Contributions (1,000 af)			
	AZ	NV	CA	Total	Percentage Additional Reduction**	AZ	NV	CA	Total	AZ	NV	CA	Total
1,090 – >1,075	192	8	0	200	2.67	75	8	117	200	267	16	117	400
1,075 – 1,050	512	21	0	533	7.11	199	21	313	533	711	42	313	1,066
<1,050 – >1,045	592	25	0	617	8.23	230	25	362	617	822	50	362	1,234
1,045 – >1,040	640	27	200	867	11.56	324	35	509	867	964	62	709	1,734
1,040 – >1,035	640	27	250	917	15.55	435	47	684	1,166	1,075	74	934	2,083
1,035 – >1,030	640	27	300	967	14.88	417	45	655	1,116	1,057	72	955	2,083
1,030 – 1,025	640	27	350	1,017	14.21	398	43	625	1,066	1,038	70	975	2,083
<1,025	720	30	350	1,100	13.11	367	39	577	983	1,087	69	927	2,083

*The additional shortage volumes decrease at elevation 1,025 feet because the shortages under the 2007 Interim Guidelines increase by the same amount. Therefore, the additional shortage amounts necessary to get to the 2.083 maf total are lower.
**Percentage of 2021 consumptive use.

B.2.4 Comparison Metrics

All modeled alternatives are compared in **Section B.3** using the following metrics:

Lake Powell

- Monthly pool elevation
- Percentages of traces that fall below an elevation of 3,490 feet in any month in a water year
- End-of-water-year pool elevation
- Annual water year release
- Ten-year Lees Ferry gage flows

Lake Mead

- Monthly pool elevation
- Percentages of traces that fall below an elevation of 1,020 feet in any month in a calendar year
- End-of-calendar-year pool elevation
- Annual calendar year release

Shortage Sharing and Water Delivery

- Depletions by Lower Division States
- Annual shortages and DCP contributions to Lower Division States
- Annual shortages, DCP contributions, and system conservation for the Lower Division States

B.3 Modeling Results

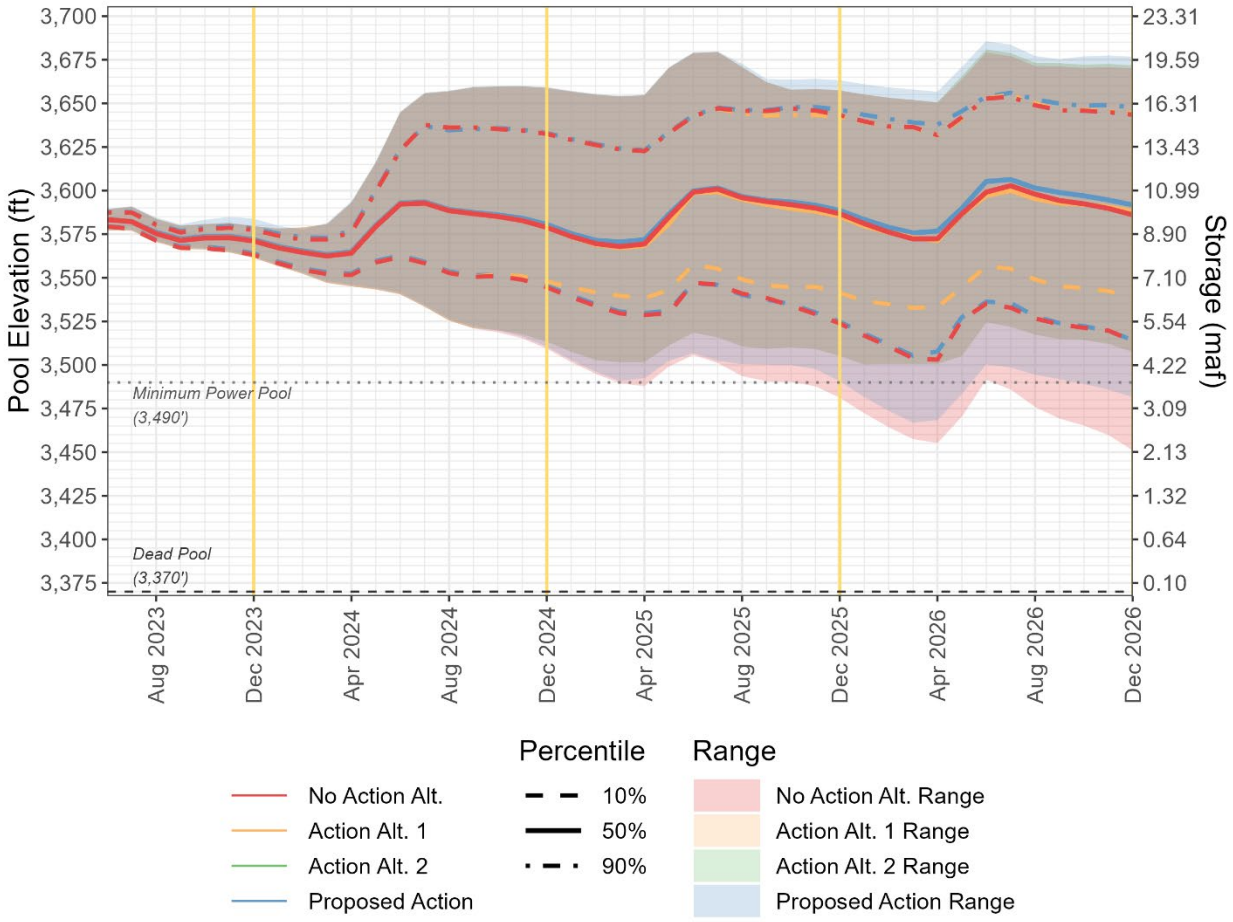
This section compares the No Action Alternative, Action Alternative 1, Action Alternative 2, and the Proposed Action. All statistics calculated reflect the hydrologic scenarios and other assumptions used in modeling; the statistics are not intended to suggest actual probabilities of any events occurring. However, it is meaningful to compare statistics across alternatives to differentiate performance. See **Appendix D** for more information about the hydrologic scenarios used and other modeling assumptions.

B.3.1 Lake Powell

Monthly Pool Elevations

Figure B-3 presents a comparison of the 10th, 50th, and 90th percentiles of modeled Lake Powell elevations for all alternatives as dashed, solid, and dash-dotted lines, respectively. It also shows "clouds" representing the full ranges of modeled elevations for the alternatives through 2026.

Figure B-3
Lake Powell End-of-Month Pool Elevations



In **Figure B-3**, the cloud extents, or full ranges of modeled Lake Powell elevations, are similar for all alternatives at the high end and median. The lower bound of the No Action Alternative and Proposed Action cloud drops to 3,500 feet in 2025 and decreases to a minimum of 3,451 feet and 3,467 feet in 2026, respectively. The lower bound of the clouds for Action Alternatives 1 and 2 does not drop below 3,490 feet; this is because these alternatives include a provision to protect a Lake Powell elevation of 3,500 feet.

In **Figure B-3,** the 10th percentiles of the No Action Alternative and Proposed Action are nearly identical; they decrease to a Lake Powell elevation of nearly 3,500 feet in April 2026. Action Alternatives 1 and 2 are highest at the 10th percentile and have the same Lake Powell elevation through 2026; this is because Glen Canyon Dam operations are the same under both alternatives.

Percentages of Traces below Critical Elevations

Figure B-4 shows the percentage of modeled traces that fall below a Lake Powell elevation of 3,490 feet at any time during a water year for 2024 through 2026. Remaining above 3,490 feet is critical to ensuring Glen Canyon Dam can continue to operate as designed.

Figure B-4
Lake Powell Minimum Water Year Elevation, Percentage of Traces Less than Elevation 3,490 Feet

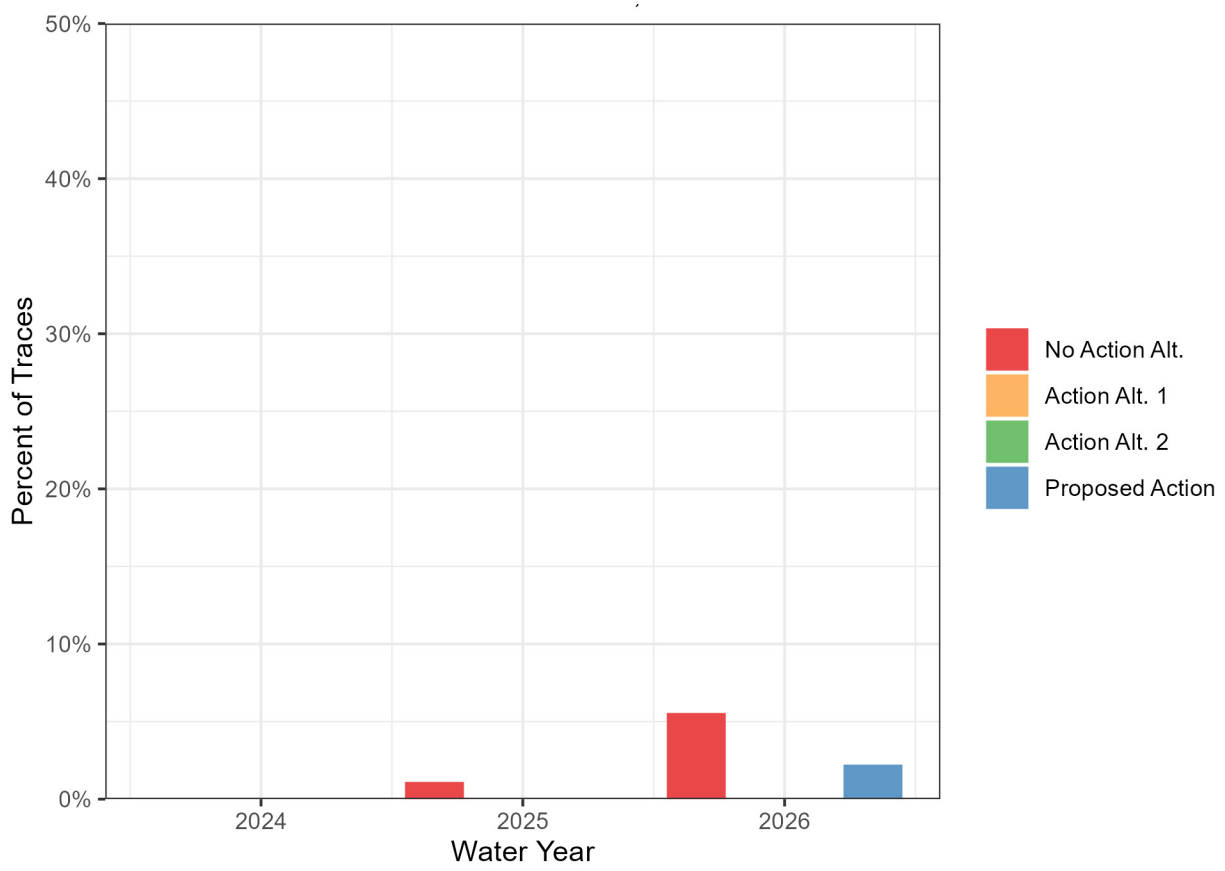


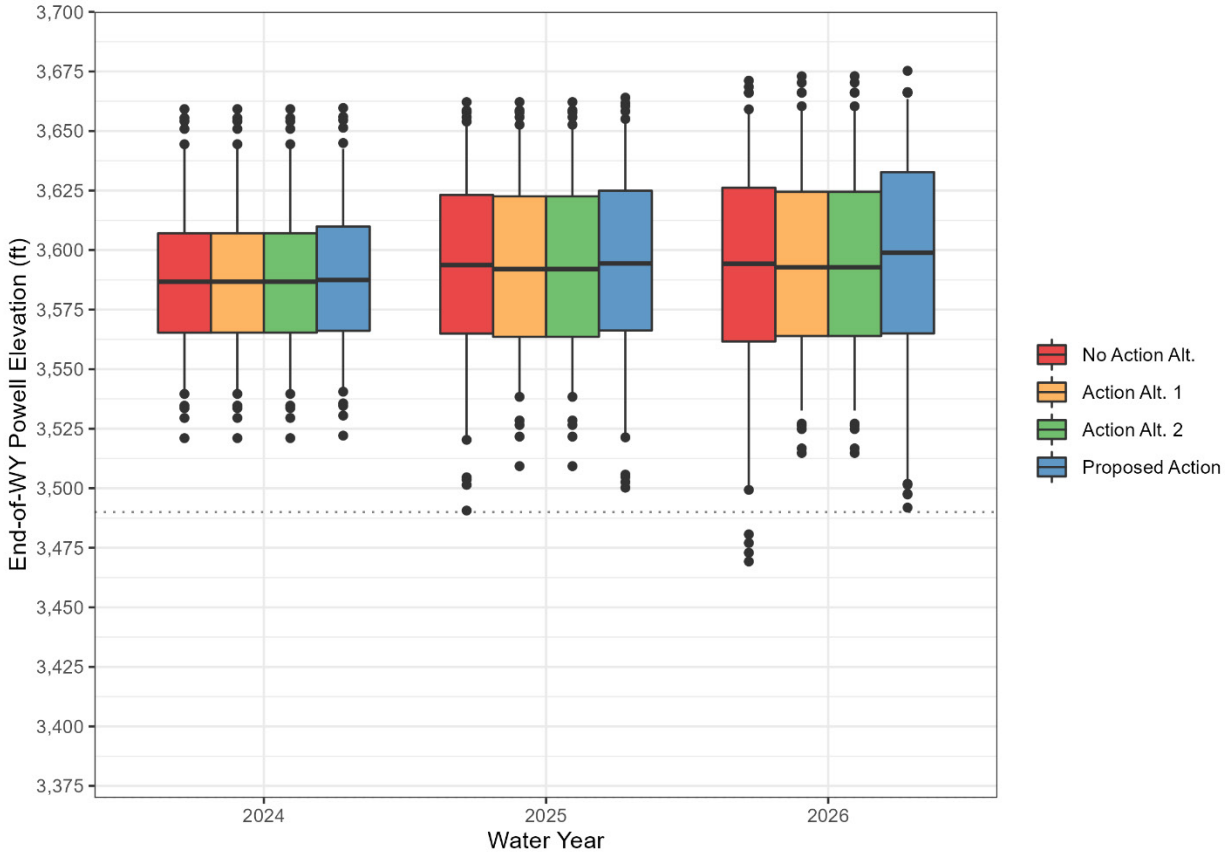
Figure B-4 shows that no alternatives drop below a Lake Powell pool elevation of 3,490 feet until 2025. Under the No Action Alternative, 1.5 percent of modeled traces in 2025 and 6.0 percent of modeled traces in 2026 result in the Lake Powell pool elevation dropping below 3,490 feet. Under Action Alternatives 1 and 2, no traces drop below a Lake Powell pool elevation of 3,490 feet due to the operations for the protection level of 3,500 feet. The Proposed Action has 2 percent of traces falling below 3,490 feet at Lake Powell in 2026.

Annual Pool Elevations

Figure B-5 shows the distributions of modeled Lake Powell elevations on September 30 in 2024, 2025, and 2026. The top and bottom of each box capture the 25th and 75th percentile, respectively, of the modeled elevations. The median is the mid-line of the box, and the whiskers extend to the 5th and 95th percentiles. The outliers are represented as dots beyond these lines.

Figure B-5 comparisons are consistent with those described above for **Figure B-3**. All alternatives have a similar range, especially at the highest pool elevations. The end-of-water-year Lake Powell pool elevations in 2025 and 2026 are lowest under the No Action Alternative, followed by the

Figure B-5
Lake Powell End-of-Water-Year Pool Elevations



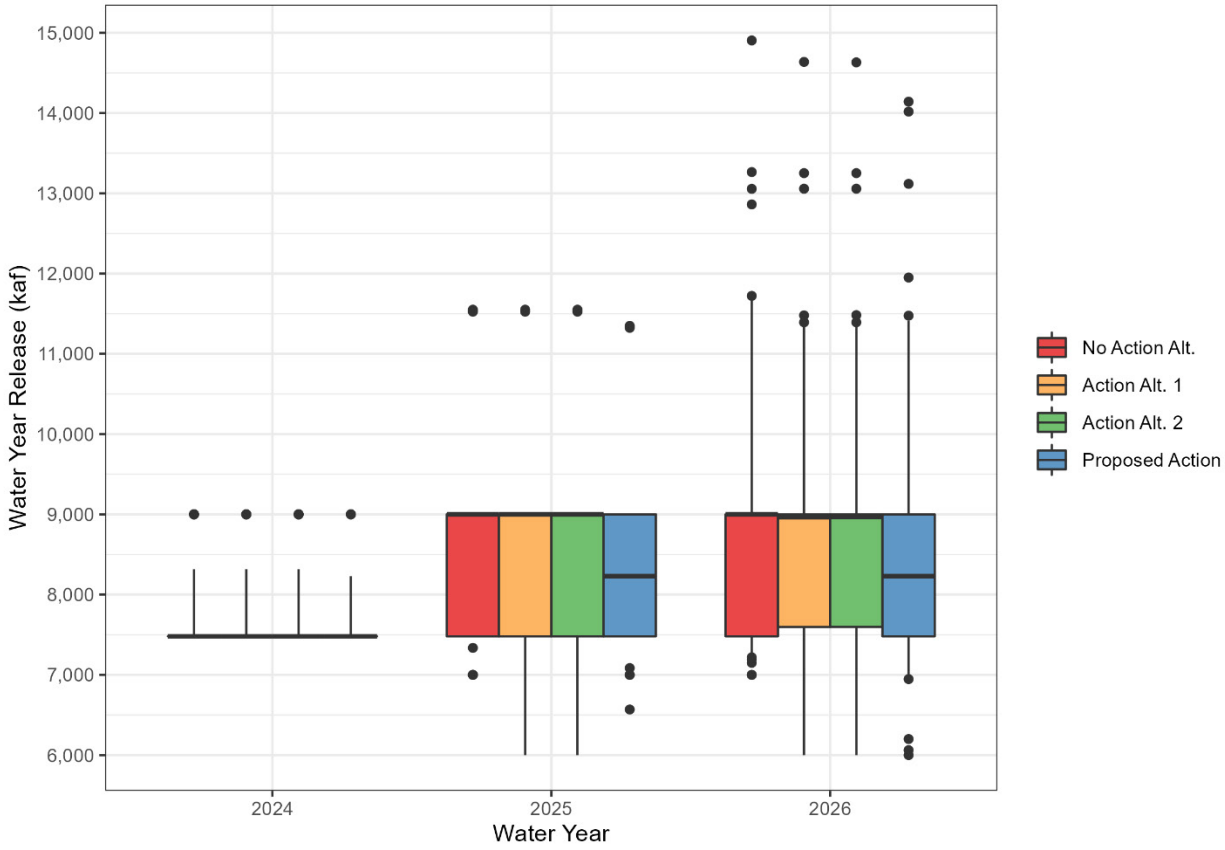
Proposed Action. Since Action Alternatives 1 and 2 protect the 3,500-foot elevation, the lowest end-of-water-year pool elevations are higher than under the No Action Alternative and the Proposed Action. The median end-of-water-year pool elevation for the Proposed Action is the highest at 3,599 feet in 2026, compared with the No Action Alternative and Action Alternatives 1 and 2, which have a median pool elevation of 3,594 and 3,593 feet, respectively.

Annual Releases

Figure B-6 shows the distributions of modeled Glen Canyon Dam water year releases in 2024, 2025, and 2026. The top and bottom of each box capture the 25th and 75th percentile, respectively, of the modeled elevations. The median is the mid-line of the box, and the whiskers extend to the 5th and 95th percentiles. The outliers are represented as dots beyond these lines.

The modeled Glen Canyon Dam water year releases shown in **Figure B-6** reflect the different approaches to Lake Powell operations assumed in the alternatives. The Proposed Action and Action Alternatives 1 and 2 limit releases to protect a Lake Powell elevation of 3,500 feet using different methods. The Proposed Action limits releases once an elevation of 3,500 feet is projected to be reached, while Action Alternatives 1 and 2 adjust releases before a 3,500-foot elevation is reached. Therefore, they have a slightly different distribution of releases at the low end.

Figure B-6
Glen Canyon Dam Water Year Releases



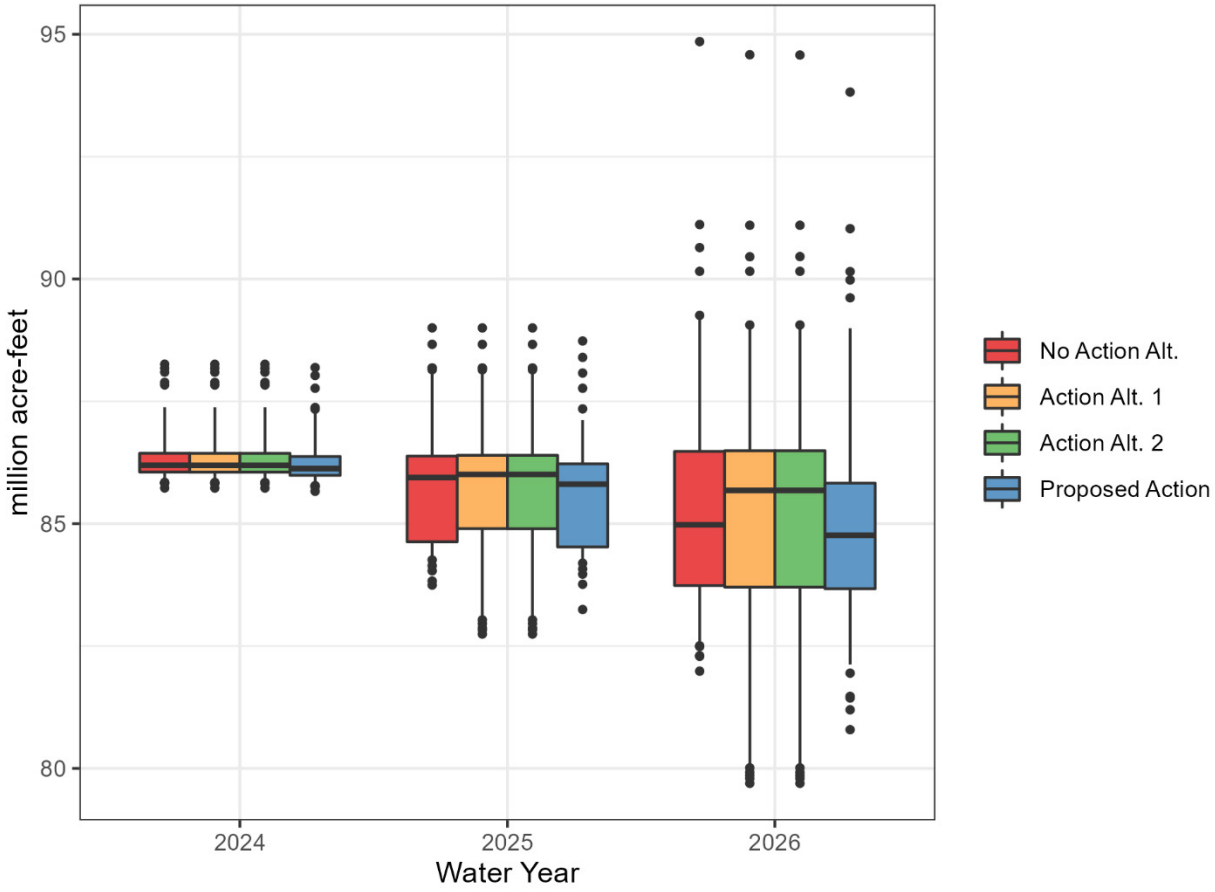
When Lake Powell is between elevations 3,500 and 3,575 feet, Action Alternatives 1 and 2 only have set release volumes (not balancing). Under Action Alternatives 1 and 2, the set releases range between 6 and 8.23 maf, which can be seen in the height of the box and whiskers. The No Action Alternative and Proposed Action set release volumes by balancing the storage of Lakes Powell and Mead when Lake Powell is below 3,525 feet; therefore, the No Action Alternative and Proposed Action have more variability in release volumes.

At the median, the No Action Alternative and Action Alternatives 1 and 2 are the same at 9.0 maf in 2025 and 2026. The Proposed Action has a lower release in 2025 and 2026. This is due to decreased balancing releases in the Upper and Lower Elevation Balancing Tiers resulting from increased storage in Lake Mead.

Ten-Year Lees Ferry Gage Flows

Figure B-7 shows the distribution of modeled 10-year running sums of Lees Ferry gage flows in 2024, 2025, and 2026. The modeled 2024 flow is calculated using the observed deliveries from 2015 through 2022, and a modeled delivery volume in 2023. There is some variability in the 2023 volume; however, it is common to all alternatives except the Proposed Action, which has small changes to balancing releases due to changes in releases from Lake Mead. The modeled 2025 volume is

Figure B-7
Lees Ferry Gage 10-Year Running Total



calculated without the 2015 observed volume, and the modeled 2026 volume is calculated without the 2015 and 2016 observed volumes.

Figure B-7 shows the 10-year volume resulting from a single hydrologic trace. The top and bottom of each box capture the 25th and 75th percentile, respectively, of the modeled elevations. The median is the mid-line of the box, and the whiskers extend to the 5th and 95th percentiles. The outliers are represented as dots beyond these lines.

Figure B-7 shows that under all alternatives, the median modeled 10-year total flows decline over time. This is partially because relatively high Glen Canyon Dam releases from 7 or more years ago drop out of the running total. All action alternatives have lower 10-year flows in the driest modeled traces than the No Action Alternative; this is because they model limited releases to protect Lake Powell's elevation of 3,500 feet.

The median 10-year flows under Action Alternatives 1 and 2 are higher than under the No Action Alternative and the Proposed Action in 2025 and 2026. The Proposed Action has the lowest median 10-year flows because Lake Powell releases are lower in 2025 and 2026. By 2025, all alternatives result in 10-year totals below 82.3 maf in some modeled traces. In 2026, 2 percent of traces fall

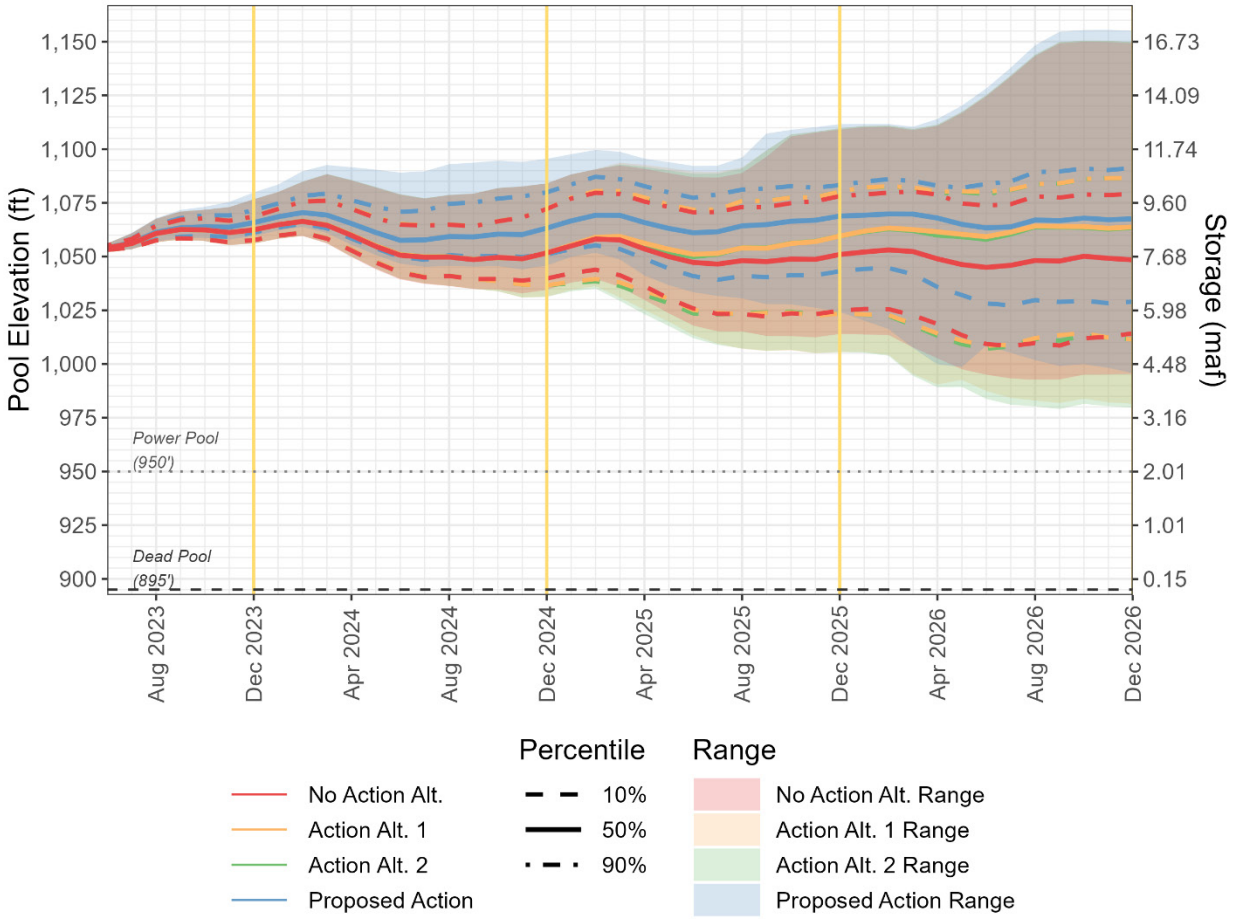
below the 10-year totals of 82.3 maf under the No Action Alternative, 16 percent of traces fall below the 10-year totals of 82.3 maf under Action Alternatives 1 and 2, and 6 percent of traces fall below the 10-year totals of 82.3 maf under the Proposed Action. There are no modeled traces that fall below 75 maf for the 10-year total.

B.3.2 Lake Mead

Monthly Pool Elevations

Figure B-8 presents a comparison of the 10th, 50th, and 90th percentiles of modeled Lake Mead elevations for all alternatives as dashed, solid, and dash-dotted lines, respectively. It also shows clouds representing the full ranges of modeled elevations for the alternatives through 2026.

Figure B-8
Lake Mead End-of-Month Pool Elevations



The upper bounds of the clouds in **Figure B-8** vary slightly between all alternatives, especially the Proposed Action. The Proposed Action's upper bound increases and is higher than the upper bound for the other alternatives, especially in 2024, due to larger volumes of SEIS conservation[2] starting in 2023. In 2026, the No Action Alternative and Action Alternatives 1 and 2 have the lowest upper bound of modeled Lake Mead elevations, while the Proposed Action has the highest upper bound. The alternatives have more variability between them at the lower bounds of the clouds. The Proposed Action has the highest lower bound at the end of 2024, while the No Action Alternative and Action Alternatives 1 and 2 have the lowest elevations at the lower bound.

In May 2026, the Proposed Action's minimum increases slightly due to adjustments in Glen Canyon Dam releases to protect 3,500 feet. These adjustments result in lower releases in April 2026 and higher releases in May 2026 as inflows to Lake Powell increase during the runoff season; these inflows can be released from Glen Canyon Dam while maintaining 3,500 feet. At the end of 2026, Action Alternatives 1 and 2 have the lowest modeled elevations at 982 feet and 980 feet, respectively, while the No Action Alternative and Proposed Action end 2026 approximately 13 to 16 feet higher at around 995 feet and 996 feet, respectively.

In **Figure B-8**, the 10th percentiles of modeled Lake Mead elevations have a slightly different result than the lower bound. At the 10th percentile, the No Action Alternative and Action Alternatives 1 and 2 are approximately the same, while the Proposed Action has higher elevations. At the median, the Proposed Action has higher pool elevations than the other alternatives through 2026. Initially, the other alternatives have a decreasing pool elevation at the median through the end of 2024. In 2025, Action Alternatives 1 and 2 start to have an increasing median pool elevation due to additional Lower Division State shortages, compared with the No Action Alternative. By the end of 2026, the Proposed Action is only 4 feet above Action Alternatives 1 and 2 at the median, while the No Action Alternative is 20 feet lower than the Proposed Action. At the 90th percentiles of modeled elevations, the No Action Alternative is lower than the other alternatives, with the Proposed Action having the highest elevations.

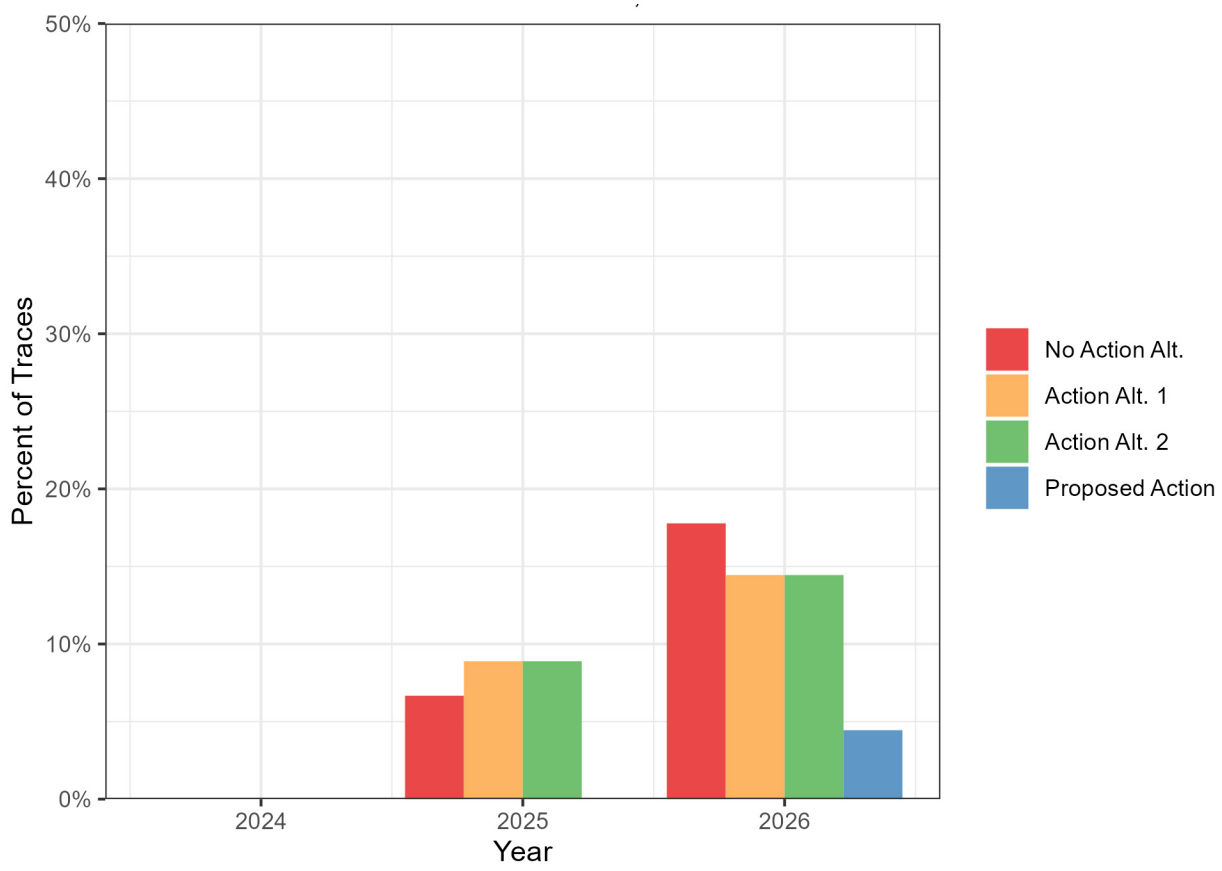
Percentages of Traces below Critical Elevations

Figure B-9 shows the percentage of modeled traces that fall below a Lake Mead elevation of 1,000 feet at any time during a year for the period of analysis. An elevation of 1,020 feet was identified as a critical elevation in the 2019 DCPs.

In **Figure B-9**, no alternatives have modeled traces falling below a Lake Mead elevation of 1,020 feet in 2024. In 2025, all alternatives except the Proposed Action have similar percentages of modeled traces falling below 1,020 feet; the No Action Alternative has approximately 7 percent, Action Alternatives 1 and 2 have the highest percentage at 9 percent, and the Proposed Action has the fewest traces at 0 percent. Over the period of analysis, the percentage of traces falling below an elevation of 1,020 feet increases under all alternatives. In 2026, the No Action Alternative has 18

[2] SEIS conservation may be a combination of system conservation, creation of ICS, or other water conservation activities that result in system benefits, as outlined in the proposal. Implementation of conservation measures would be subject additional environmental compliance, as appropriate.

Figure B-9
Lake Mead Minimum Calendar Year Elevation, Percentage of Traces Less than Elevation 1,020 Feet



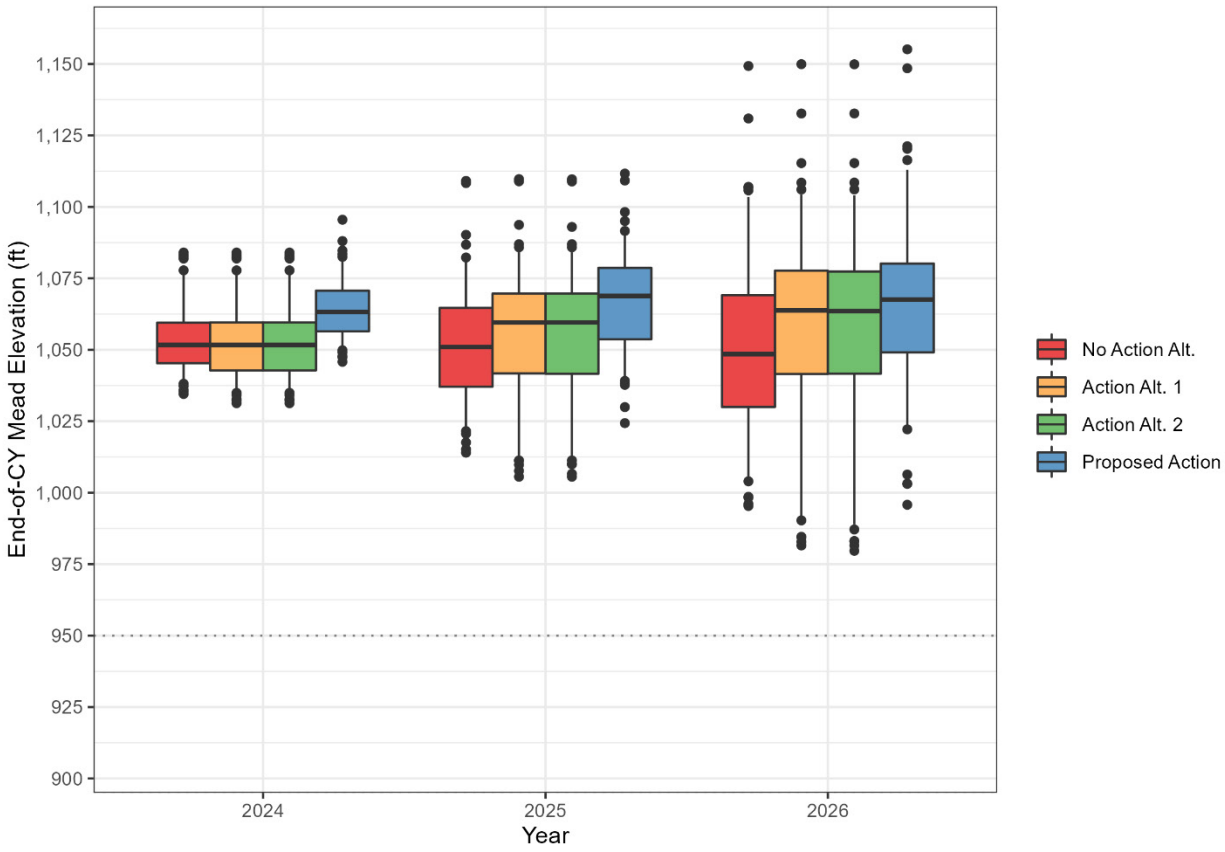
percent of traces falling below 1,020 feet, Action Alternatives 1 and 2 have 14 percent of traces, and the Proposed Action has 4 percent of traces.

Annual Pool Elevations

Figure B-10 shows the distributions of modeled Lake Mead elevations on December 31 in 2024, 2025, and 2026. The top and bottom of each box capture the 25th and 75th percentile, respectively, of the modeled elevations. The median is the mid-line of the box, and the whiskers extend to the 5th and 95th percentiles. The outliers are represented as dots beyond these lines.

The distributions of modeled end-of-calendar-year Lake Mead elevations for the alternatives shown in **Figure B-10** exhibit the same dynamics as those described under **Figure B-8**. The medians of the No Action Alternative decline from 2024 to 2026, and the variability increases. Action Alternatives 1 and 2 display wide ranges in all years, but the medians and ranges consistently shift upward over the period of analysis. Compared with the other alternatives, the Proposed Action has the highest pool elevation at all quantiles from 2024 to 2026.

Figure B-10
Lake Mead End-of-Calendar-Year Pool Elevations

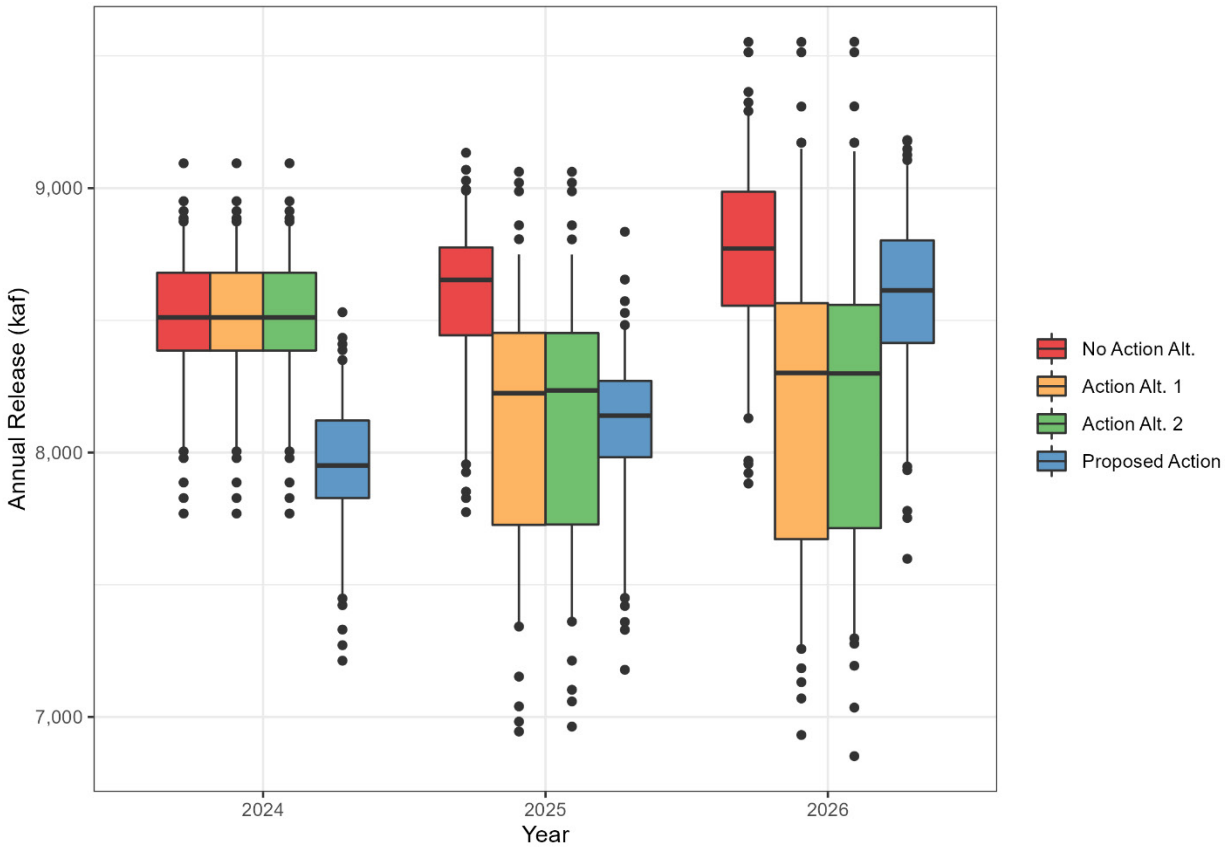


Annual Releases

Figure B-11 shows the distributions of modeled annual releases from Hoover Dam in 2024, 2025, and 2026. The top and bottom of each box capture the 25th and 75th percentile, respectively, of the modeled elevations. The median is the mid-line of the box, and the whiskers extend to the 5th and 95th percentiles. The outliers are represented as dots beyond these lines.

Figure B-11 shows that under the No Action Alternative, the modeled releases from Hoover Dam in 2024 to 2025 have ranges of approximately 1.3 maf, with medians that increase slightly from approximately 8.51 to 8.65 maf. In 2026, the median release again increases slightly to 8.77 maf, while the highest releases increase to above 9.5 maf. In 2024, Action Alternatives 1 and 2 have the same releases as the No Action Alternative. In 2025 and 2026, releases are lower than under the No Action Alternative, and variability increases due to the potential of increased Lower Division State shortage volumes. With a median of 7.95 maf, the Proposed Action has lower releases than the other alternatives in 2024. In 2025, the release increases but is still lower than it is under Action Alternatives 1 and 2 at the median. In 2026, the Proposed Action release is higher at the median at 8.61 maf and has less variability than under Action Alternatives 1 and 2; however, the median is still lower than it is under the No Action Alternative.

Figure B-11
Hoover Dam Calendar Year Releases



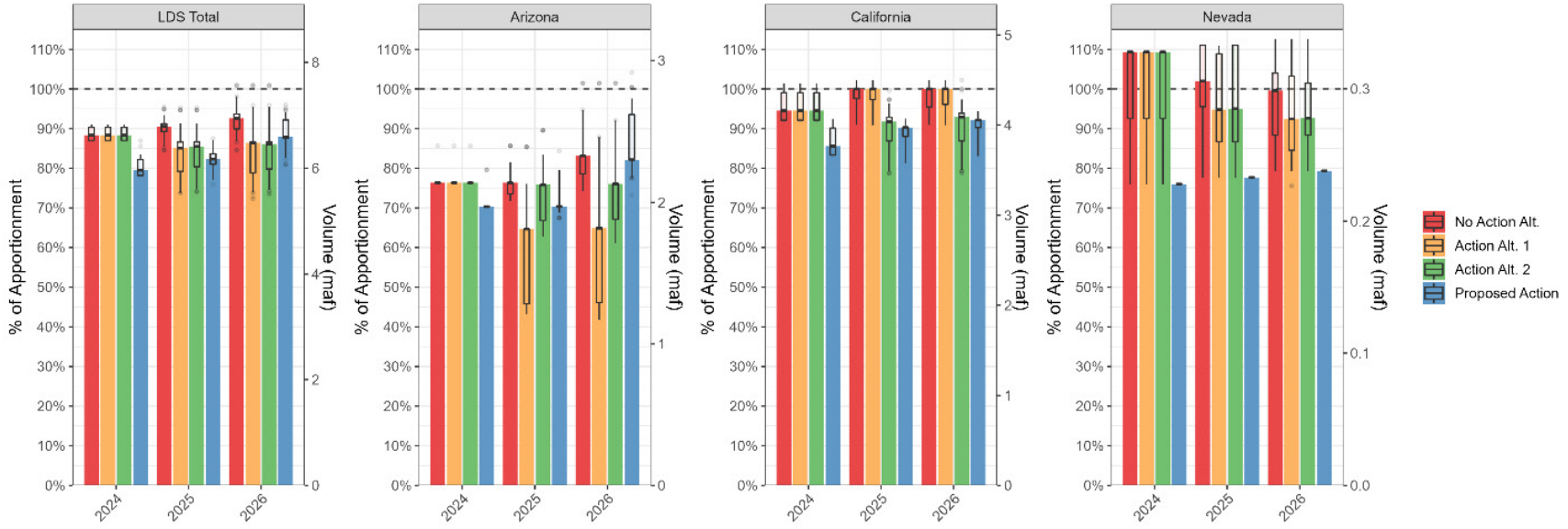
B.3.3 Shortage Sharing and Water Delivery

Lower Division Depletions by State

Figure B-11 shows the distribution of modeled Lower Division States' depletions represented as a percentage of the state's apportionment and by volumes in 2024, 2025, and 2026. The median depletions are represented by the colored bar and the mid-line of each box. The top and bottom of each box capture the 25th and 75th percentile, respectively, of the modeled depletions, and the whiskers extend to the 5th and 95th percentiles. The outliers are represented as dots beyond these lines. From left to right, the four panels display depletions for the Lower Division States (the total), Arizona, California, and Nevada, respectively. The figure is oriented to facilitate the comparison of a state's modeled depletions across each alternative over the period of analysis.

Figure B-12 reports the distributions of modeled Lower Division States' depletions that would occur after adjustments to demands based on shortages, DCP contributions, ICS delivery or creation, and system conservation.

Figure B-12
Lower Division States' Modeled Depletions



The left panel of **Figure B-12** shows a comparison of how total modeled Lower Division States' depletions were affected by the different alternatives. In 2024, the No Action Alternative and Action Alternatives 1 and 2 show the same median depletions at 88 percent of apportionment; this is because no additional shortages are applied in 2024 for Action Alternatives 1 and 2. The Proposed Action depletion for 2024 is lower than for the other alternatives at 80 percent of apportionment; this is because an additional Lower Division State system conservation was modeled. In 2025 and 2026, the medians for Action Alternatives 1 and 2 decline, and the variability increases due to additional shortages taking effect. The median for the No Action Alternative is the highest among the alternatives in 2025 and 2026. The Proposed Action results in lower use than the other alternatives in 2025 and slightly higher depletions than Action Alternatives 1 and 2 in 2026.

In the second panel of **Figure B-12**, Arizona's modeled annual 2025 and 2026 depletions are lowest under Action Alternative 1. Under Action Alternative 1, shortages are applied based exclusively on the concept of priority, so Arizona's junior users are significantly affected. The No Action Alternative and Action Alternative 2 have similar depletions in 2025; this is due to additional shortages and a reduction in system conservation modeled in Action Alternative 2. The No Action Alternative and Proposed Action have higher depletions in 2026 than Action Alternatives 1 and 2 since no additional shortages are applied in those alternatives.

In the third panel of **Figure B-12**, modeled annual depletions for California are highest under the No Action Alternative and Action Alternative 1 throughout the period of analysis; this is because there are no additional shortages applied to California due to high-priority users under those alternatives. In 2025 and 2026, Action Alternative 2 and the Proposed Action have similar median depletions, with a larger range in Action Alterative 2. Action Alternative 2 has additional shortage applied to California when shortage volumes are distributed based on each user's consumptively used water, while the Proposed Action includes system conservation.

The fourth panel of **Figure B-12** shows the modeled annual depletions for Nevada. In 2024, median depletions for all alternatives except the Proposed Action are approximately 109 percent of apportionment. This is a result of how the ICS accumulation space[3] sharing is modeled for these alternatives. An ICS accumulation space-sharing agreement allows states to share ICS accumulation space up to the total capacity of 2.7 maf. In 2024, some model traces show the ICS accumulation at capacity. Since Nevada is using more than the state's individual maximum ICS accumulation, Nevada is modeled to vacate the ICS so another state can create ICS. When this occurs, it is assumed that Nevada takes delivery of Nevada's vacated ICS up to the state's maximum delivery, which results in depletions above Nevada's apportionment. This also occurs in 2025 and 2026. The Proposed Action does not have depletions above Nevada's apportionment since it is assumed that Nevada converts vacated ICS to system water instead of taking delivery of the volume. Due to this assumption, the depletions under the Proposed Action are substantially lower than they are under the other alternatives.

[3] In accordance with the Lower Basin DCP, the maximum total amount of Extraordinary Conservation ICS, Binational ICS, and DCP ICS that may be accumulated by the Lower Division States is 2.7 maf.

Annual Shortage and DCP Contribution Volumes by State

Figure B-13 shows the distributions of modeled shortages plus DCP contributions to Lower Division States represented as a percentage of apportionment and volumes in 2024, 2025, and 2026. The volumes represent water required to meet DCP contributions, 2007 ROD shortages, and additional proposed shortages during a year. The median reductions are represented by the colored bar and the mid-line of each box. The top and bottom of each box capture the 25th and 75th percentile, respectively, of the modeled elevations, and the whiskers extend to the 5th and 95th percentiles. The outliers are represented as dots beyond these lines. From left to right, the four panels display shortage and DCP contributions for Lower Division States (the total), Arizona, California, and Nevada, respectively.

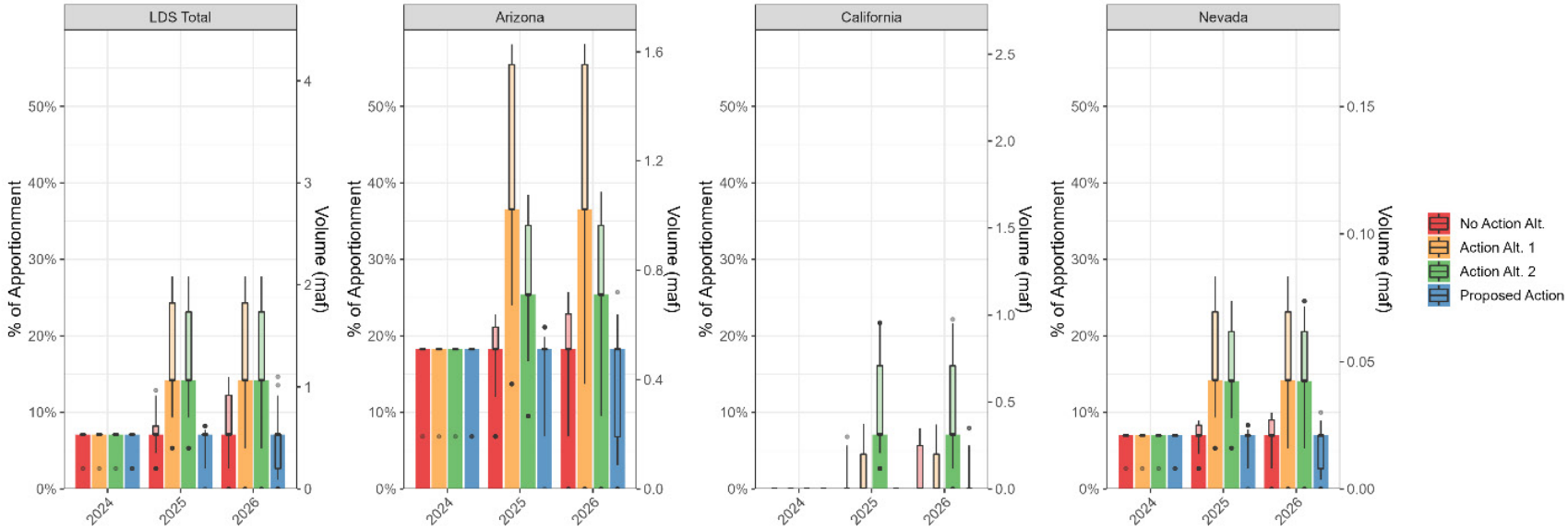
The left panel in **Figure B-13** shows that 2024 Lower Division States' total shortages and DCP contributions are the same across all alternatives since the alternatives have the same 2024 Lake Mead operating condition. In 2025 and 2026, Lower Division States' total shortages and DCP contributions for the No Action Alternative and Proposed Action are similar at the median with 7 percent of apportionment. Also, Action Alternatives 1 and 2 are similar at the median with 14 percent of apportionment. The range of shortages and DCP contributions in 2025 and 2026 for Action Alternatives 1 and 2 is larger than it is for the other alternatives due to the wider range of potential shortages.

The distributions of modeled Arizona shortages and DCP contributions shown in the second panel of **Figure B-13** reflect dynamics between alternatives that have been observed in previous figures and discussions. The No Action Alternative and Proposed Action have lower shortages and DCP contributions than Action Alternatives 1 and 2. Delivery reductions under Action Alternative 1 are higher than they are under Action Alternative 2; this is because Action Alternative 1 distributes shortage volumes based on the concept of priority, as opposed to using the same percentage across all Lower Basin water users to distribute shortages.

The third panel in **Figure B-13** shows the same dynamics in modeled distributions of California's shortages and DCP contributions that were described for Arizona, except the relative higher and lower magnitudes between Action Alternatives 1 and 2 are reversed. Distributing shortages based fully or largely on proportionality results in higher reductions for California under Action Alternative 2; using the priority system as a basis for Action Alternative 1 results in lower delivery reduction volumes for California.

With respect to modeled shortages and DCP contributions assigned to Nevada, the right panel of **Figure B-13** shows that distributing shortages based on the concept of priority versus using the same percentages across all Lower Basin water users is not as strong of a determinant of magnitudes as it is for Arizona and California. Action Alternatives 1 and 2 have the same shortages and DCP contributions at the median, with Action Alternative 1 having a slightly higher maximum shortage compared with Action Alternative 2. Consistent with the other states, the No Action Alternative and Proposed Action have the same shortages and DCP contributions.

Figure B-13
Distribution of Lower Division Shortages and DCP Contributions



Annual Shortage, DCP Contribution, and System Conservation Volumes by State

Figure B-14 shows the distributions of modeled shortages, DCP contributions, and system conservation to Lower Division States represented as a percentage of apportionment and volumes in 2024, 2025, and 2026. The figure reflects **Figure B-13** with the addition of system conservation volumes. The median reductions are represented by the colored bar and the mid-line of each box. The top and bottom of each box capture the 25th and 75th percentile, respectively, of the modeled elevations, and the whiskers extend to the 5th and 95th percentiles. The outliers are represented as dots beyond these lines. From left to right, the four panels display the total shortages, DCP contributions, and system conservation for Lower Division States (the total), Arizona, California, and Nevada, respectively.

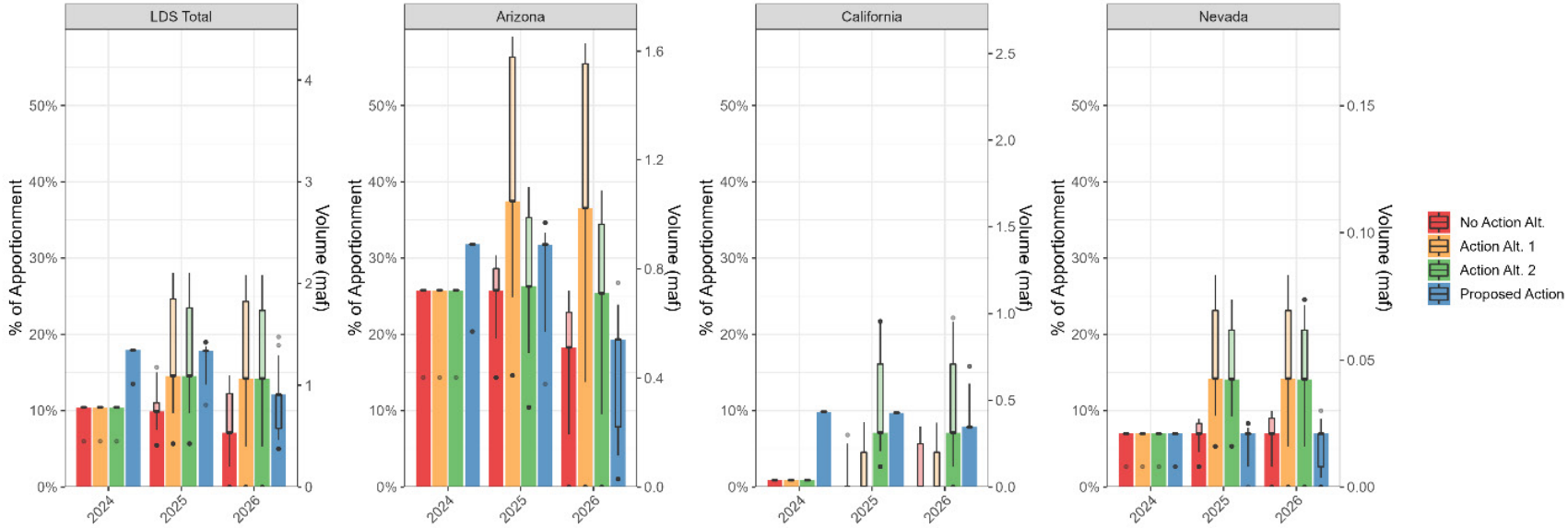
The left panel in **Figure B-14** reflects the difference in system conservation between the alternatives. In 2024 and 2025, the Proposed Action has more system conservation than the other alternatives, resulting in higher volumes that are approximately at 18 percent of Lower Division States' apportionment at the median. Compared with Action Alternatives 1 and 2, under the Proposed Action the assumed system conservation in 2025 results in larger shortages, DCP contributions, and system conservation volumes. In 2026, the Proposed Action has lower volumes than Action Alternatives 1 and 2 since less system conservation is assumed to occur in 2026.

The distributions of modeled Arizona shortages, DCP contributions, and system conservation shown in the second panel of **Figure B-14** reflect the addition of system conservation volumes to **Figure B-13**. The Proposed Action has higher volumes than the other alternatives in 2024. In 2025, Action Alternative 1 has higher volumes at 38 percent of apportionment compared with the Proposed Action, which is 32 percent of apportionment. In 2026, Action Alternatives 1 and 2 have higher volumes than the Proposed Action, which has volumes similar to those under the No Action Alternative at the median.

The third panel in **Figure B-14** shows the Proposed Action has larger total shortages, DCP contributions, and system conservation volumes for California than the other alternatives. In 2024, the Proposed Action results in volumes of 10 percent of apportionment, which are all due to system conservation. The other alternatives have lower volumes at 1 percent of apportionment due to lower assumed system conservation. In 2025 and 2026, Action Alternative 2 has total shortages, DCP contributions, and system conservation volumes only slightly below those of the Proposed Action at the median, while the No Action Alternative and Action Alterative 1 have volumes at 0 percent of apportionment at the median.

With respect to modeled total shortages, DCP contributions, and system conservation volumes assigned to Nevada, the right panel of **Figure B-14** is the same as the panel for Nevada in **Figure B-13**. There is no assumed system conservation for any alternatives in Nevada. The Proposed Action assumes changed assumptions for ICS (see the discussion for **Figure B-12**); this results in different depletions but does not affect the volumes in **Figure B-14**.

Figure B-14
Distribution of Lower Division Shortages, DCP Contributions, and System Conservation



B.4 Summary

At Lake Powell, modeling for the alternatives shows similar monthly and end-of-water-year elevations at the median and high end of the range. Compared with the No Acton Alternative, all three alternatives have higher lower bounds of elevations and a lower incidence of reaching 3,490 feet; this is because they include some protection of elevation 3,500 feet. Action Alternatives 1 and 2 and the Proposed Action show variation over time and are comparable with one another in their distributions of Glen Canyon Dam releases based on whether they include balancing releases below a Lake Powell elevation of 3,575 feet and the volumes of specified releases below 3,575 feet. Action Alternatives 1 and 2 have no balancing below 3,575 feet after 2024; also, their modeled median releases are stable in 2025 and 2026 at 9 maf with ranges that tend to increase over time. The Proposed Action median modeled Glen Canyon Dam releases are lower than they are for the other alternatives by approximately 0.77 maf in 2025 and 2026. The No Action Alternative's medians are similar to the medians of Action Alternatives 1 and 2.

Because of the assumption to protect a Lake Powell elevation of 3,500 feet, there are more modeled traces resulting in 10-year Lees Ferry gage flows less than 82.3 maf in 2026 under Action Alternatives 1 and 2 and the Proposed Action. In 2026, depending on the alternative, 6 to 16 percent of traces fall below 82.3 maf over 10 years under Action Alternatives 1 and 2 and the Proposed Action.

At Lake Mead, the Proposed Action differs from the other alternatives because it includes additional SEIS conservation in 2023 through 2026. Thus, monthly and end-of-calendar-year pool elevations are higher under the Proposed Action for the analysis period. Median pool elevations for Action Alternatives 1 and 2 are higher than they are under the No Action Alternative starting in 2025, which is when additional shortage volumes take effect for Action Alternatives 1 and 2. A combination of increased shortages under Action Alternatives 1 and 2 and decreased Glen Canyon Dam releases under the Proposed Action causes the median modeled Lake Mead elevations under Action Alternatives 1 and 2 to increase up to the elevations for the Proposed Action starting in 2025. At the end of 2026, the elevations under Action Alternatives 1 and 2 are 20 feet below the elevations under the Proposed Action. This dynamic is reflected in the percentage of traces that drop below 1,020 feet at Lake Mead in 2026; the Proposed Action results in 4 percent of traces dropping below 1,020 feet, while Action Alternatives 1 and 2 and the No Action Alternative have 14 and 18 percent of traces, respectively.

Releases from Hoover Dam are significantly lower under Action Alternatives 1 and 2 and the Proposed Action than releases modeled under the No Action Alternative. This is because Action Alternatives 1 and 2 and the Proposed Action apply additional shortages or SEIS conservation. The release medians and ranges for Action Alternatives 1 and 2 are generally consistent in 2025 and 2026, while the releases under the Proposed Action increase through the analysis period based on modeled SEIS conservation and lower shortage volumes.

In terms of shortage sharing and water deliveries to the Lower Division States, three major factors drive the differences among Action Alternatives 1 and 2 and the Proposed Action: (1) additional shortage volumes, (2) how shortages are distributed among users, and (3) assumed system conservation volumes. Overall, Action Alternatives 1 and 2 result in higher modeled shortages (and lower modeled depletions) in 2025 and 2026 than the No Action Alternative. The Proposed Action results in only minor differences in shortages compared with the No Action Alternative. However, when system conservation is considered, reductions are more similar to those under Action Alternatives 1 and 2, though exact volumes vary by year. In 2024, depletions are lower for the Proposed Action than for the other alternatives; however, in 2025 and 2026, depletions are approximately the same as they are for Action Alternatives 1 and 2.

The additional shortages applied to individual states vary among Action Alternatives 1 and 2, which are the only alternatives that assume additional shortages. Action Alternative 1 uses the concept of priority as the basis for distributing additional shortages. This results in the modeled shortages and DCP contributions being relatively higher in Arizona and lower in California, compared with Action Alternative 2. In contrast, Action Alternative 2 bases additional shortage distributions on the proportions of water used by different users; this results in relatively higher magnitudes of reductions in California and lower reductions in Arizona. For Nevada, the two approaches to distributing shortages do not have a strong impact on shortage magnitudes.

When system conservation and additional shortages are both considered, the Proposed Action shows higher reductions for California than any of the other alternatives. For Arizona, the Proposed Action has lower reductions than Action Alternative 1 but higher reductions than Action Alternative 2 in 2025 and reductions similar to the No Action Alternative in 2026. Since Nevada has no assumed system conservation, additional reductions are only due to additional shortages under Action Alternatives 1 and 2. Changes in modeled ICS behavior result in much lower depletions by Nevada under the Proposed Action compared with under the other alternatives.

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Attachment B-1

Action Alternatives 1 and 2 CRMMS Modeling Assumptions

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Attachment B-1. CRMMS Modeling Assumptions

This attachment describes the CRMMS modeling assumptions for Action Alternatives 1 and 2. CRMMS modeling assumptions for the No Action Alterative and Proposed Action are detailed in **Appendix D**. The assumptions common to all alternatives in **Appendix D, Section D.6.1** and **Section D.7.1** also apply to Action Alternatives 1 and 2.

B-1.1 Lake Powell Operations under Action Alternatives 1 and 2

The Lake Powell operations under Action Alternatives 1 and 2 are the same. For operating year 2023 and 2024, CRMMS solves for Lake Powell operations as described for the No Action Alternative (**Appendix D, Section D.6.2**). For operating years 2025 and 2026, CRMMS solves for the Lake Powell operating tier and operating year release as follows using the projected physical pool elevation:

- If the projected Lake Powell end-of-calendar-year pool elevation is greater than or equal to the equalization level (**Appendix D**, **Table D-8**), the Equalization Tier operations govern the operating year releases (see **Section D.6.3.1**).
- If the Lake Powell end-of-calendar-year pool elevation is less than the equalization level and greater than or equal to 3,575 feet, the Upper Elevation Balancing Tier governs the operating year releases (see **Section D.6.3.2**).
- If the Lake Powell end-of-calendar-year pool elevation is less than 3,575 feet, the new Lower Elevation Release Tier governs the operating year releases (see **Section D.6.3.3**).

The operating year release calculation for each tier is described below for Action Alternatives 1 and 2.

B-1.1.1 Equalization Tier

The Equalization Tier method for Lake Powell under Action Alternatives 1 and 2 is identical to that under the No Action Alternative (**Appendix D**, **Section D.6.2**).

B-1.1.2 Upper Elevation Balancing Tier

The Upper Elevation Balancing Tier method for Lake Powell under Action Alternatives 1 and 2 is identical to that under the No Action Alternative (**Appendix D**, **Section D.6.2**).

B-1.1.3 Lower Elevation Release Tier

Operating year 2023 operates in the Lower Elevation Balancing Tier, as set by the August 2022 24-Month Study. The calculation of the Lake Powell annual release for operating year 2023 is identical

to that for the No Action Alternative (**Appendix D**, **Section D.6.2**). Operating year 2024 also operates consistent with operating year 2024 under the No Action Alternative.

For operating years beyond 2024, the Lower Elevation Release Tier is modeled by first setting the annual release volume to 8.23 maf. Lake Powell resolves with the 8.23-maf annual release for monthly releases and pool elevations. Next, a rule checks the projected Lake Powell end-of-water-year pool elevation (for example, September 30, 2024, when the model is executing in August 2023) and sets the operating year release as follows:

- If the projected Lake Powell end-of-water-year pool elevation is greater than or equal to 3,575 feet, set the operating year release to 8.23 maf.
- If the projected Lake Powell end-of- water-year pool elevation is less than 3,575 feet and greater than or equal to 3,550 feet, set the operating year release to 7.48 maf.
- If the projected Lake Powell end-of-water-year pool elevation is less than 3,550 feet and greater than or equal to 3,525 feet, set the operating year release to 7.00 maf.
- If the Lake Powell end-of-water-year pool elevation is less than 3,525 feet, set the operating year release to 6.00 maf.

B-1.1.4 Protection Level

Action Alternatives 1 and 2 specify a protection level at Lake Powell such that if, in any month, Lake Powell's elevation is below 3,500 feet, the Lake Powell release would be set to maintain or increase the elevation with a maximum release of 6.0 maf. The goal would be to maintain LTEMP minimum flows, subject to run-of-the-river conditions, operational constraints, and prudent operations as determined by Reclamation.

In CRMMS, this is modeled by constraining monthly releases to ensure the pool elevation does not drop below 3,500 feet. If the operating year starts with Lake Powell below 3,500 feet and if the monthly release will cause the elevation to decrease, then the monthly release is decreased to maintain the current elevation. It is also constrained by the river outlet works' capacity. If the monthly outflow results in an increase in pool elevation, the method will try to release any constrained volume from earlier in the operating year while staying above the protection elevation of 3,500 feet.

If Lake Powell is greater than or equal to 3,500 feet at the beginning of the operating year, then all monthly releases are constrained such that the end-of-month pool elevation does not fall below 3,500 feet. The constrained release volume is tracked throughout the operating year. If a release for a given month is above 3,500 feet, then the method will try to release the previously constrained volume such that Lake Powell remains at or above 3,500 feet at the end of the month.

B-1.1.5 Disaggregation from Annual to Monthly Release

Lake Powell operating year releases are disaggregated to monthly releases using the same method used for the No Action Alternative. To assist in the solution of monthly releases, an additional column was added to **Table Attachment D-1** for a 6.0-maf annual release (**Table Attachment B-1**). This monthly distribution is used for modeling purposes only.

Table Attachment B-1
Monthly Distribution of Lake Powell Releases for a 6.0-maf Annual Release (af)

Annual Total	6,000,000
October	410,000
November	430,000
December	510,000
January	570,000
February	500,000
March	530,000
April	470,000
May	470,000
June	500,000
July	560,000
August	600,000
September	450,000

B-1.2 Lake Mead Operations under Action Alternatives 1 and 2

In CRMMS, Lake Mead operations are modeled by solving for the Lower Basin condition, Lower Basin and Mexico diversions, and ICS and other conservation activity.

B-1.2.1 Action Alternative 1

The Lake Mead operations and Lower Basin conditions for Action Alternative 1 are similar to those under the No Action Alternative (that is, the shortage and DCP contribution volumes are based on Lake Mead elevations). For operating years 2023 and 2024, CRMMS solves for the Lake Mead operations as described in the No Action Alternative; the physical pool elevation is used to calculate Lake Mead operations and the Lower Basin conditions. For operating years 2025 and 2026, CRMMS solves for the Lake Mead operations and Lower Basin conditions using the physical elevations at Lake Mead with additional shortages applied at different Lake Mead elevations.

Surplus

The surplus model assumptions for the Lower Basin under Action Alternative 1 are identical to those under the No Action Alternative (**Appendix D**, **Section D.7.2**).

Normal Condition

The normal condition model assumptions for the Lower Basin under Action Alternative 1 are identical to those under the No Action Alternative (**Appendix D**, **Section D.7.2**).

Shortage Condition

Under Action Alternative 1, for operating years 2025 and 2026, the Lower Basin is modeled to operate in a shortage condition when the projected Lake Mead end-of-calendar-year pool elevation is at or below 1,090 feet. For 2023 and 2024, operations are identical to those under the No Action Alterative. In CRMMS, a rule solves for the shortage condition in January by comparing Lake

Mead's previous end-of-calendar-year pool elevation with the defined pool elevations in **Table Attachment B-2**; the total Lower Division States' shortage volumes correspond to the shortage condition and operating year in **Table Attachment B-2**. The total shortage is then distributed by priority among the Lower Division States and water users by following the method used in the shortage allocation model for Action Alternative 1 (see **Appendix E**, Shortage Allocation Model Documentation).

Table Attachment B-2
Lower Division States' Shortages and DCP Contributions (1,000 af)

Lake Mead Elevation (feet)	Shortages	DCP Contributions	Additional Shortages under Action Alternatives 1 and 2	Total Combined (Shortages + DCP Contributions)
	2007 Interim Guidelines	2019 DCPs	Additional Shortage in 2025–2026	Action Alts 1 and 2 2025–2026
1,090 to >1,075	0	200	200	400
1,075 to 1050	333	200	533	1,066
<1,050 to >1,045	417	200	617	1,234
1,045 to >1,040	417	450	867	1,734
1,040 to >1,035	417	500	1,166	2,083
1,035 to >1,030	417	550	1,116	2,083
1,030 to 1,025	417	600	1,066	2,083
<1,025	500	600	983	2,083

The distribution of shortages among water users was computed outside CRMMS and is applied in two stages. When distributing shortage volumes by priority using the shortage allocation model method, total reductions include the reductions specified by the 2007 ROD and 2019 DCPs. In Stage 1, Nevada and Arizona users are shorted. Nevada is assigned 4 percent of the total reduction, which is Nevada's apportionment divided by the total Lower Division States' apportionment (that is, 300,000 af/7,500,000 af). The remainder of the total reduction is assigned to Arizona, which is 96 percent of the total reduction. Once Arizona Priority 4 entitlements are fully shorted (that is, water use is set to zero), Stage 2 is entered.

In Stage 2, all Lower Division States' uses are reduced proportionally to the remaining consumptive uses scheduled in CRMMS. Reductions taken by Nevada and Arizona in Stage 1 are subtracted from each state's annual scheduled consumptive use when determining state reductions.

$$Stage2Reduction_n = Stage2Reduction * \left(\frac{ScheduledUse_n - Stage1Reduction_n}{LDSTotalUse - Stage1Reduction}\right)$$

where *n* is an individual state.

Once the total state reductions are calculated for each Lower Basin shortage condition, total reductions are split into reduction types (that is, 2007 ROD shortage, Action Alternative 1 shortage, and 2019 DCP contributions). The 2019 DCP contributions can be larger than the specified additional shortage based on the modeled application of Action Alternative 1. In this case, the larger volume is applied, which causes larger total reductions than the volumes based on a given elevation range. A summary of the modeled shortage by state and priority for Action Alternative 1 is in **Attachment B-3**, **Table Attachment B-7**, **Table Attachment B-8**, and **Table Attachment B-9**. Tables are provided for 2025 and 2026 separately because CRMMS depletion schedules vary slightly each year, which results in slightly different distributions of shortages.

Within each state, reductions are distrusted by priority, where the lowest-priority users are shorted completely before shorting any higher-priority user. The assumed priorities of CRMMS users are summarized in **Attachment B-3**. Shortages that are assigned to a specific priority are distributed proportionally across users in a priority group based on CRMMS input annual water depletion schedules.

$$MonthlyShortage_i = AnnualShortage_P * \left(\frac{AnnualWaterUse_i}{AnnualWaterUse_P}\right) * \left(\frac{MonthlyWaterUse_i}{AnnualWaterUse_i}\right)$$

where *P* is a group of water users in the same priority within a state, and *i* is the specific water user within the priority group.

Minute 323 High- and Low-Elevation Reservoir Conditions

The Minute 323 model assumptions for the Lower Basin under Action Alternative 1 are identical to those under the No Action Alternative.

DCP and BWSCP

The DCP and BWSCP model assumptions for the Lower Basin under Action Alternative 1 are identical to those under the No Action Alternative.

ICS

The ICS model assumptions for the Lower Basin under Action Alternative 1 are identical to those under the No Action Alternative.

System Conservation

In addition to shortage and DCP contributions based on Lake Mead operations, Lower Basin demands are assumed to be reduced for system conservation after agreements have been finalized. **Table Attachment B-3** shows the system conservation modeled for Action Alternative 1. The volumes in 2023 and 2024 match those under the No Action Alternative.

Table Attachment B-3
System Conservation under Action Alternative 1

Modeled SEIS Conservation	2023	2024	2025	2026	Total
California					
System Conservation					
Palo Verde Irrigation District	58,400	39,800	—	—	98,200
California Total	**58,400**	**39,800**	**—**	**—**	**98,200**
Arizona					
System Conservation					
Gila River Indian Community	91,950	125,000	—	—	216,950
Fort McDowell Yavapai Nation	13,933	13,933	—	—	27,866
Central Arizona Project Subcontractors	62,200	42,200	—	—	104,400
Mohave Valley Irrigation and Drainage District	12,819	—	—	—	12,819
Yuma Mesa Irrigation and Drainage District	13,670	—	—	—	13,670
Gabrych Farms	3,240	3,240	—	—	6,480
Arizona Total	**197,812**	**184,373**	**—**	**—**	**382,185**
Total Modeled System Conservation	**256,212**	**224,173**	**—**	**—**	**480,385**

B-1.2.2 Action Alternative 2

The Lake Mead operations and Lower Basin conditions under Action Alternative 2 are similar to those under the No Action Alternative (that is, shortage and DCP contribution volumes are based on Lake Mead elevations). For operating years 2023 and 2024, CRMMS solves for Lake Mead operations as described in the No Action Alternative; the physical pool elevation is used to calculate Lake Mead operations and the Lower Basin conditions. For operating years 2025 and 2026, CRMMS solves for the Lake Mead operations and Lower Basin conditions using the physical elevations at Lake Mead with additional shortages applied at different Lake Mead elevations.

Surplus

The surplus model assumptions for the Lower Basin under Action Alternative 2 are identical to those under the No Action Alternative.

Normal Condition

The normal condition model assumptions for the Lower Basin under Action Alternative 2 are identical to those under the No Action Alternative.

Shortage Condition

Under Action Alternative 2, the Lower Division States' total shortage volumes are the same as they are under Action Alternative 1 (**Table Attachment B-2**); however, the shortage distribution between states and water users is different. For Action Alternative 2, shortages in addition to the 2007 ROD shortages and 2019 DCP contributions are distributed in the same percentage across all Lower Basin water users based on the 2021 adjusted consumptive use for CRMMS water users. The

total shortage distributed among the Lower Division States and water users follows the method used in the shortage allocation model for Action Alternative 2 (see **Appendix D**).

The distribution of shortages to individual water users is performed outside CRMMS. Specific shortage volumes for each water user and the shortage conditions are input into CRMMS. These shortages are computed by determining the percentage reduction for each water user based on the additional shortage's percentage of the total Lower Division States' consumptive use:

$$UserAdditionalShortage_i = \frac{TotalLDSShortage}{7{,}500{,}000} * UserDepletionScheduleUse_i$$

where i is each Lower Division State's water user modeled in CRMMS.

In applying shortages and DCP contributions under Action Alternative 2, first, the 2007 ROD shortages and 2019 DCP contributions are applied to the users identified in these CRMMS modeling assumptions. Then, the additional shortages are applied using the above equation. A rule applies the shortage to water users by spreading the annual shortage over all months proportionally to the users' monthly depletion schedules.

$$MonthlyShortage_i = AnnualShortage_i * \left(\frac{MonthlyWaterUse_i}{AnnualWaterUse_i}\right)$$

where *i* is an individual water user.

A summary of the modeled shortage by state for Action Alternative 2 is in **Attachment B-3**, **Table Attachment B-9**.

Minute 323 High- and Low-Elevation Reservoir Conditions

The Minute 323 model assumptions for the Lower Basin under Action Alternative 2 are identical to those under the No Action Alternative.

DCP and BWSCP

The DCP and BWSCP model assumptions for the Lower Basin under Action Alternative 2 are identical to those under the No Action Alternative.

ICS

The ICS model assumptions for the Lower Basin under Action Alternative 2 are identical to those under the No Action Alternative.

System Conservation

The system conservation assumptions for the Lower Basin under Action Alternative 2 are identical to those under Action Alternative 1.

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Attachment B-2

CRMMS Lower Basin Water User Priorities

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Attachment B-2. CRMMS Lower Basin Water User Priorities

Table Attachment B-4 through **Table Attachment B-6** list the CRMMS users and the corresponding assumed priorities that are used for purposes of distributing shortages under Action Alternative 1. Water user depletion schedules are summarized in **Appendix D**, **Table Attachment D-2**. The water user names are provided exactly as they show up in CRMMS; abbreviations are not defined.

Table Attachment B-4
CRMMS Water Users by Priority for Arizona

Arizona		
Priority 1 (P1)	**Priority 2, 3 (P2,3)**	**Priority 4 (P4)**
AzPumpersBlwImp P1	CibolaNWR	AzPumpersAbvImp
BrookeWater P1	City of Yuma P3	AzPumpersBlwImp P4
City of Parker P1	DavisDamProject	AzPumpersDvsToPkr
City of Yuma P1	DesertLawnMemorial	BrookeWater P4
Cocopah Indian Res	Gila Monster Farms P2,3	BullheadCity
CRIRAz	HavasuNWR	CAP P4
Ft Yuma	ImperialNWR	CibolaValleyIID
FtMohaveAz	LMNRA Az Mead	City of Parker P4
Gila Monster Farms P1	LMNRA Az Mohave	Ehrenberg
MohaveValleyIID P1	MCAirStation	Gila Monster Farms P4
NGVIDD P1	NGVIDD P 2,3	GoldenShores
UnitB P1	SouthernPacific	LakeHavasuCity
YCWUA P1	UnitB P2,3	MohaveValleyIID P4
	UofA	MohaveWaterConsDist
	WMIDD	
	YAO	
	YCWUA P2,3	
	YID	
	YMIDD	
	YumaProvingGround	
	YumaUnionHighScl	
	CAP P3	

Table Attachment B-5
CRMMS Water Users by Priority for Nevada

Nevada		
Present Perfected Rights (PPRs)	**SNWP Non-PPRs**	**Non-PPRs, Non-SNWP**
FtMohaveNv	BasicManagement	BigBend
LMNRA Mead PPR	BoulderCanyonProject	LMNRA Mohave P2
LMNRA Mohave PPR	City of Henderson	SCE
	LMNRA Mead P2	
	LVWashReturns	
	NvDeptFishGame	
	PacificCoastBuilding	
	SNWADiversion	
	SNWP	

Table Attachment B-6
CRMMS Water Users by Priority for California

California					
Present Perfected Rights (PPRs)	**Priority 1 (P1)**	**Priority 2 (P2)**	**Priority 3 (P3)**	**Priority 4 (P4)**	**No Priority (Pnone)**
CaPumpersDvsToPkr - PPR	PaloVerde P1	YumaProject	Coachella	MWD	CaPumpersAbvImp
Chemehuevi			IID – P3		CaPumpersDvsToPkr-Pnone
CRIRCa					SaltonSea
FtMohaveCa					YumaIsland
FYIR_Ranches					
IID – PPR					
Needles					
PaloVerde PPR					
Winterhaven					
YumaProject					

Attachment B-3

CRMMS Action Alternatives' Shortages and DCP Contributions

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Attachment B-3. CRMMS Action Alternatives' Shortages and DCP Contributions

Table Attachment B-7 through **Table Attachment B-9** include the assumed shortages and DCP contributions by state and priority (for Action Alternative 1) that were computed using the methods described in **Sections B.7.3.3** and **B.7.4.3**. These shortage volumes are imported to CRMMS to model Action Alternatives 1 and 2. Different tables are provided for 2025 and 2026 because CRMMS depletion schedules vary slightly between 2025 and 2026; this causes slightly different distributions of shortages.

Table Attachment B-7
2025 Action Alternative 1 CRMMS Shortages and DCP Contributions Table by State and Priority (values in af)

Lake Mead (feet)	Interim Guidelines Shortages		DCP Contributions			Additional Shortages[1]								Total Reductions			Lower Division States Total
	AZ	NV	AZ	NV	CA	AZ-P4	AZ-P2,3	NV	CA-P4 and CA-Pnone	CA-P3	CA-P2	CA-P1	CA-PPR	AZ	NV	CA	
>1,090	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1,090–1,075	0	0	192,000	8,000	0	192,000	0	8,000	0[2]	0[2]	0[2]	0[2]	0[2]	384,000	16,000	0	400,000
1,075–1050	320,000	13,000	192,000	8,000	0	511,360	0	21,640	0[2]	0[2]	0[2]	0[2]	0[2]	1,023,360	42,640	0	1,066,000
1,050–1,045	400,000	17,000	192,000	8,000	0	592,640	0	24,360	0[2]	0[2]	0[2]	0[2]	0[2]	1,184,640	49,360	0	1,234,000
1,045–1,040	400,000	17,000	240,000	10,000	200,000	880,311	32,011	42,389	0[2]	0[2]	0[2]	0[2]	0[2]	1,552,322	69,389	200,000	1,821,711
1,040–1,035	400,000	17,000	240,000	10,000	250,000	880,311	106,320	56,417	122,953	0	0	0	0	1,626,630	83,417	372,953	2,083,000
1,035–1,030	400,000	17,000	240,000	10,000	300,000	880,311	106,320	56,417	72,953	0	0	0	0	1,626,630	83,417	372,953	2,083,000
1,030–1,025	400,000	17,000	240,000	10,000	350,000	880,311	106,320	56,417	22,953	0	0	0	0	1,626,630	83,417	372,953	2,083,000
<1,025	480,000	20,000	240,000	10,000	350,000	800,311	106,320	53,417	22,953	0	0	0	0	1,626,630	83,417	372,953	2,083,000

Footnotes:
[1]AZ-P4 = Arizona Priority 4; AZ-P2,3 = Arizona Priority 2 and Priority 3; CA-P4 = California Priority 4; CA-Pnone = California users with no priority; CA-P3 = California Priority 3; CA-P2 = California Priority 2; CA-P1 = California Priority 1; CA-PPR = California Priority Perfected Right; CRMMS users are categorized by priority in **Table Attachments B-4**, **B-5**, and **B-6**.

[2]In this elevation tier, the 2019 DCP contributions for California exceed what would be required under Action Alternative 1. As a result, no additional shortage is required in this elevation tier for California.

Disclaimer: These modeling inputs (for Action Alternative 1) should only be used to compare the relative magnitude of effects reasonably expected to occur under the alternatives evaluated in this SEIS. Modeling assumptions should not be taken as Reclamation's position with respect to contract or statutory interpretation, and they are not intended to limit Secretarial discretion with respect to current or future policy. This modeled methodology is not a substitute for the annual process of reviewing water orders and determining which can be filled; the model methodology cannot replicate the precision required of that annual process.

Table Attachment B-8
2026 Action Alternative 1 CRMMS Shortages and DCP Contributions Table by State and Priority (values in af)

Lake Mead (feet)	Interim Guidelines Shortages		DCP Contributions			Additional Shortages[2]								Total Reductions			Lower Division States Total
	AZ	NV	AZ	NV	CA	AZ-P4	AZ-P2,3	NV	CA-P4 and CA-Pnone	CA-P3	CA-P2	CA-P1	CA-PPR	AZ	NV	CA	
>1,090	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1,090–1,075	0	0	192,000	8,000	0	192,000	0	8,000	0[1]	0[1]	0[1]	0[1]	0[1]	384,000	16,000	0	400,000
1,075–1050	320,000	13,000	192,000	8,000	0	511,360	0	21,640	0[1]	0[1]	0[1]	0[1]	0[1]	1,023,360	42,640	0	1,066,000
1,050–1,045	400,000	17,000	192,000	8,000	0	592,640	0	24,360	0[1]	0[1]	0[1]	0[1]	0[1]	1,184,640	49,360	0	1,234,000
1,045–1,040	400,000	17,000	240,000	10,000	200,000	880,311	32,519	42,360	0[1]	0[1]	0[1]	0[1]	0[1]	1,552,830	69,360	200,000	1,822,190
1,040–1,035	400,000	17,000	240,000	10,000	250,000	880,311	108,007	56,320	121,363	0	0[1]	0	0[1]	1,628,317	83,320	371,363	2,083,000
1,035–1,030	400,000	17,000	240,000	10,000	300,000	880,311	108,007	56,320	71,363	0	0	0	0	1,628,317	83,320	371,363	2,083,000
1,030–1,025	400,000	17,000	240,000	10,000	350,000	880,311	108,007	56,320	21,363	0	0	0	0	1,628,317	83,320	371,363	2,083,000
<1,025	480,000	20,000	240,000	10,000	350,000	800,311	108,007	53,320	21,363	0	0	0	0	1,628,317	83,320	371,363	2,083,000

Footnotes:

[1]In this elevation tier, the 2019 DCP contributions for California exceed what would be required under Action Alternative 1. As a result, no additional shortage is required in this elevation tier for California.

[2]AZ-P4 = Arizona Priority 4; AZ-P2,3 = Arizona Priority 2 and Priority 3; CA-P4 = California Priority 4; CA-Pnone = California users with no priority; CA-P3 = California Priority 3; CA-P2 = California Priority 2; CA-P1 = California Priority 1; CA-PPR = California Priority Perfected Right; CRMMS users are categorized by priority in **Table Attachments B-4**, **B-5**, and **B-6**.

Disclaimer: These modeling inputs (for Action Alternative 1) should only be used to compare the relative magnitude of effects reasonably expected to occur under the alternatives evaluated in this SEIS. Modeling assumptions should not be taken as Reclamation's position with respect to contract or statutory interpretation, and they are not intended to limit Secretarial discretion with respect to current or future policy. This modeled methodology is not a substitute for the annual process of reviewing water orders and determining which can be filled; the modeled methodology cannot replicate the precision required of that annual process.

Table Attachment B-9
2025–2026 Action Alternative 2 CRMMS Shortage Volume Table (values in af)

Lake Mead Pool Elevation (feet)	Interim Guidelines Shortages		DCP Contributions			Additional Shortages			Total Shortages			Lower Division States Total
	AZ	NV	AZ	NV	CA	AZ	NV	CA	AZ	NV	CA	
>1,090	0	0	0	0	0	0	0	0	0	0	0	0
1,090–1,075	0	0	192,000	8,000	0	74,666	8,001	117,333	266,666	16,001	117,333	400,000
1,075–1050	320,000	13,000	192,000	8,000	0	198,986	21,321	312,693	710,986	42,321	312,693	1,066,000
1,050–1,045	400,000	17,000	192,000	8,000	0	230,349	24,680	361,971	822,349	49,680	361,971	1,234,000
1,045–1,040	400,000	17,000	240,000	10,000	200,000	323,677	34,681	508,642	963,677	61,681	708,642	1,734,000
1,040–1,035	400,000	17,000	240,000	10,000	250,000	435,307	46,640	684,053	1,075,307	73,640	934,053	2,083,000
1,035–1,030	400,000	17,000	240,000	10,000	300,000	416,640	44,639	654,721	1,056,640	71,639	954,721	2,083,000
1,030–1,025	400,000	17,000	240,000	10,000	350,000	397,974	42,640	625,386	1,037,974	69,640	975,386	2,083,000
<1,025	480,000	20,000	240,000	10,000	350,000	366,988	39,319	576,693	1,086,988	69,319	926,693	2,083,000

Disclaimer: These modeling inputs (for Action Alternative 2) should only be used to compare the relative magnitude of effects reasonably expected to occur under the alternatives evaluated in this SEIS. Modeling assumptions should not be taken as Reclamation's position with respect to contract or statutory interpretation, and they are not intended to limit Secretarial discretion with respect to current or future policy. This modeled methodology is not a substitute for the annual process of reviewing water orders and determining which can be filled; the modeled methodology cannot replicate the precision required of that annual process.

Appendix C

Original Draft SEIS Action Alternatives 1 and 2

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Appendix C. Original Draft SEIS Action Alternatives 1 and 2

C.1 Introduction

This appendix describes Action Alternatives 1 and 2 from the original Draft SEIS, which was withdrawn after submittal of the Lower Division Proposal.

C.2 Action Alternative 1

This alternative describes a set of actions adopted pursuant to Secretarial authority under applicable federal law. Unlike current operations that were developed, and are being implemented, pursuant to basin-wide consensus (for example, the 2007 Interim Guidelines and the 2019 DCPs), Action Alternative 1 models changes to operations for both Glen Canyon Dam and Hoover Dam as developed by Reclamation. Action Alternative 1 includes assumptions for reduced releases from Glen Canyon Dam and additional Lower Basin shortages based on the concept of priority.[1] Action Alternative 1 models releases between 6.0 maf and 8.23 maf from Lake Powell when it is below 3,575 feet, with potentially lower releases to preserve the elevation of 3,500 feet.[2]

Action Alternative 1 models progressively larger additional shortages as Lake Mead's elevation declines. It also models larger additional shortages in 2025–2026 as compared with 2024. The total shortages and DCP contributions in 2024, as modeled, are limited to 2.083 maf. This is because this is the maximum volume analyzed in the 2007 FEIS, and to analyze shortages greater than 2.083 maf would require additional detailed analysis and stakeholder coordination. Working within this range of previously analyzed impacts will facilitate completing this SEIS process in the time available in advance of the 2024 operating year. Delaying operational decisions to perform additional analyses would not meet the express purpose of and need for this action.

For all operations, including, but not limited to when Lake Powell is approaching 3,500 feet or when Lake Mead is approaching 950 feet, the Secretary reserves the right to operate Reclamation facilities to address extraordinary circumstances, as described in Section 7(D) of the 2007 Interim Guidelines, including "operations that are prudent or necessary for safety of dams, public health and safety,

[1] Priority refers the distribution of Colorado River water in the Lower Division States of Arizona, California, and Nevada as subject to laws, judicial rulings and decrees, contracts, interstate compacts, and operating criteria, known as the "Law of the River," which apportion available water between the states and establish certain priorities in use.
[2] The action alternatives would protect an elevation of 3,500 feet in Lake Powell to provide a buffer above minimum power pool, which is at 3,490 feet.

other emergency situations, or other unanticipated or unforeseen activities arising from actual operating experience."

C.2.1 Shortage Guidelines

Table C-1 shows the Lower Basin shortages under the 2007 Interim Guidelines, contributions under the 2019 DCPs, and additional shortages modeled under Action Alternative 1 in calendar year 2024. Assumptions regarding the breakdown of shortages and contributions by state, according to priority, are shown in **Table C-2**. Reclamation may consider additional shortages in Shortage Condition Year 2025 and 2026 (see **Table C-3**). This consideration would occur as part of the future analysis referenced in **Section 1.2** before the 2025 operating year operating condition determination.

Figure C-1 shows a graphical view of Lower Basin shortages and contributions from the 2007 Interim Guidelines and the 2019 DCPs plus additional shortages modeled under Action Alternative 1.

Whenever Lake Mead's content is projected to be below an elevation of 1,000 feet, based on the January 1 projection or a mid-year review, additional reductions may be needed to protect the minimum power pool (elevation 950 feet) and to reduce the risk of declining to dead pool (elevation 895 feet).

Table C-1
Lower Division States' Shortages and DCP Contributions, Action Alternatives 1 and 2 (2024)*

Lake Mead Elevation (feet)	No Action Alternative			Additional Shortages under Action Alternatives 1 and 2 (2024)	
	2007 ROD Shortages (1,000 af)	2019 DCP Contributions (1,000 af)	No Action Total (1,000 af)	2024 Additional Shortages (1,000 af)	2024 Total Shortages + Contributions (1,000 af)
1,090 – >1,075	0	200	200	200	**400**
1,075 – 1,050	333	200	533	533	**1,066**
<1,050 – >1,045	417	200	617	617	**1,234**
1,045 – >1,040	417	450	867	867	**1,734**
1,040 – >1,035	417	500	917	1,166	**2,083**
1,035 – >1,030	417	550	967	1,116	**2,083**
1,030 – 1,025	417	600	1,017	1,066	**2,083**
<1,025 – 1,000	500	600	1,100	983	**2,083**
<1,000 – 975	500	600	1,100	983	**2,083**
<975 – 950	500	600	1,100	983	**2,083**
<950	500	600	1,100	983	**2,083**

* This table only shows combined Lower Division State shortage volumes and DCP contributions. In addition to the volumes shown in this table, the analysis for each alternative includes water delivery reductions to Mexico under low-elevation reservoir conditions and Mexico's savings that contribute to the Binational Water Scarcity Contingency Plan, in accordance with Minute 323 to the 1944 Water Treaty.

Table C-2
Lower Division States' Shortages and DCP Contributions by State, Action Alternative 1 (2024)

Lake Mead Elevation (feet)	2007 ROD Shortage + 2019 DCP Contributions (1,000 af)				2024 Action Alternative 1 Additional Shortage* (1,000 af)				2024 Total Shortages + Contributions (1,000 af)			
	AZ	NV	CA	Total	AZ	NV	CA	Total	AZ	NV	CA	Total
1,090 – >1,075	192	8	0	200	192	8	0	200	384	16	0	400
1,075 – 1,050	512	21	0	533	511	22	0	533	1,023	43	0	1,066
<1,050 – >1,045	592	25	0	617	593	24	0	617	1,185	49	0	1,234
1,045 – >1,040	640	27	200	867	1,025	42	0**	1,067	1,665	69	200	1,734***
1,040 – >1,035	640	27	250	917	1,098	56	12	1,166	1,738	83	262	2,083
1,035 – >1,030	640	27	300	967	1,098	56	0**	1,154	1,738	83	300	2,083***
1,030 – 1,025	640	27	350	1,017	1,098	56	0**	1,154	1,738	83	350	2,083***
<1,025 – 1,000	720	30	350	1,100	1,018	53	0**	1,071	1,738	83	350	2,083***
<1,000 – 975	720	30	350	1,100	1,018	53	0**	1,071	1,738	83	350	2,083***
<975 – 950	720	30	350	1,100	1,018	53	0**	1,071	1,738	83	350	2,083***
<950	720	30	350	1,100	1,018	53	0**	1,071	1,738	83	350	2,083***

*The additional shortage volumes decrease at elevation 1,025 feet because the shortages under the 2007 Interim Guidelines increase by the same amount. Therefore, the additional shortage amounts necessary to get to the 2.083 maf total are lower.

**In this elevation tier, the 2019 DCP contributions for California exceed what would be required under Action Alternative 1. As a result, no additional shortage is required in this elevation tier for California.

***Because the 2019 DCP contributions for California exceed the 2024 total shortage and contribution volume as modeled by the Action Alternative 1 Shortage Allocation Model, the sum of the three state totals exceeds the total shortage and contribution volume. While the total amount of the three states' total shortage and contribution volume exceeds 2.083 maf in the elevation tiers below elevation 1,035 feet, the ROD would not exceed a total shortage and contribution volume of 2.083 maf in calendar year 2024.

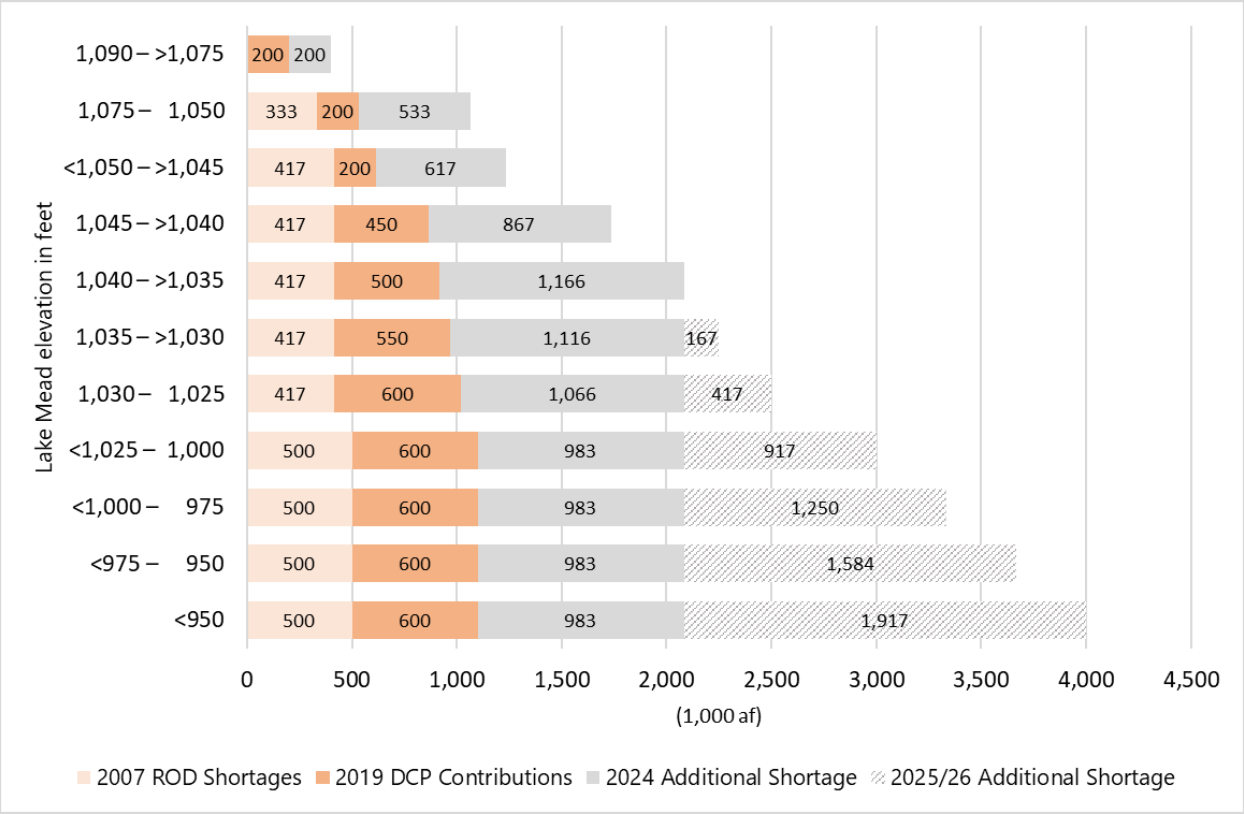
Table C-3
Lower Division States' Shortages and DCP Contributions, Action Alternatives 1 and 2 (2025–2026)*

Lake Mead Elevation (feet)	No Action Alternative			Additional Shortages under Action Alternatives 1 and 2 (2025–2026)	
	2007 ROD Shortage (1,000 af)	2019 DCP Contributions (1,000 af)	No Action Total (1,000 af)	2025–2026 Additional Shortage** (1,000 af)	2025–2026 Total Shortages + Contributions (1,000 af)
1,090 – >1,075	0	200	200	200	**400**
1,075 – 1,050	333	200	533	533	**1,066**
<1,050 – >1,045	417	200	617	617	**1,234**
1,045 – >1,040	417	450	867	867	**1,734**
1,040 – >1,035	417	500	917	1,166	**2,083**
1,035 – >1,030	417	550	967	1,283	**2,250**
1,030 – 1,025	417	600	1,017	1,483	**2,500**
<1,025 – 1,000	500	600	1,100	1,900	**3,000**
<1,000 – 975	500	600	1,100	2,233	**3,333**
<975 – 950	500	600	1,100	2,567	**3,667**
<950	500	600	1,100	2,900	**4,000**

* This table only shows combined Lower Division State shortage volumes and DCP contributions. In addition to the volumes shown in this table, the analysis for each alternative includes water delivery reductions to Mexico under low-elevation reservoir conditions and Mexico's savings that contribute to the Binational Water Scarcity Contingency Plan, in accordance with Minute 323 to the 1944 Water Treaty.

The scope of this NEPA analysis, including potential actions in 2025–2026, is discussed further in **Sections 1.2 and **1.5**.

Figure C-1
Modeled Lower Basin Shortages and DCP Contributions, Action Alternatives 1 and 2



C.2.2 Coordinated Reservoir Operations

Under Action Alternative 1, the annual Lake Powell release is based on the volume of water in storage or the corresponding elevation of Lake Powell and Lake Mead, as described in the operational tiers below (see **Table C-4**). The Equalization and Upper Elevation Balancing Tiers are the same as under the No Action Alternative. The Mid-Elevation Release Tier and Lower Elevation Balancing Tier are combined into a single Lower Elevation Release Tier, and a Protection Level is also included. The applicable operational tier is based on the August 24-Month Study projections of the January 1 system storage and reservoir water surface elevations for the following operating year.

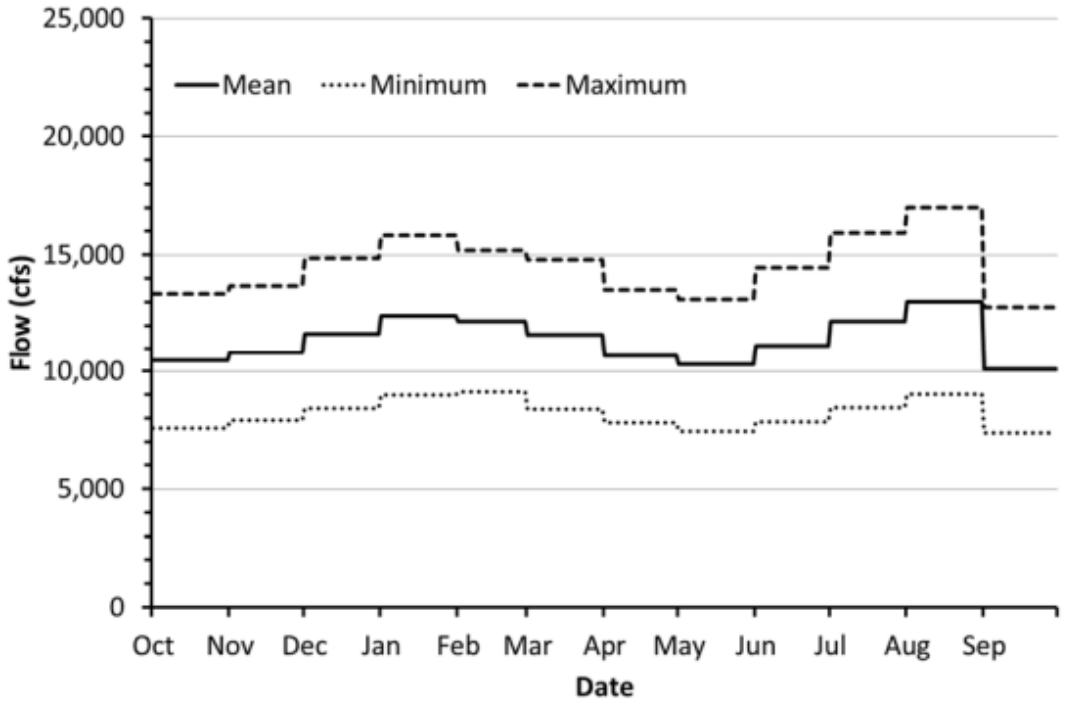
Hourly, daily, and monthly releases from Lake Powell for coordinated operations would be consistent with the parameters of the ROD for the LTEMP EIS (Reclamation and NPS 2016). Monthly releases from Glen Canyon Dam would be distributed proportionally across months for annual releases below 7.0 maf (see **Figure C-2** for monthly distributions in a year when the annual release is 8.23 maf). If annual flows were adjusted mid-year, they would be distributed to meet the goals of the LTEMP, including potential distribution across monthly or experimental flow patterns, and including the unique resource considerations specific to any mid-year annual adjustments.

Table C-4
Lake Powell Operational Tiers, Action Alternatives 1 and 2

Lake Powell Operational Tiers (subject to April adjustments or mid-year review modifications)		
Lake Powell Elevation (feet)	**Lake Powell Operational Tier**	**Lake Powell Active Storage*** (maf)
3,700	**Equalization Tier** Equalize, avoid spills, or release 8.23 maf	**23.31**
3,636–3,666 (see Table 2.3-1 in the 2007 FEIS)	**Upper Elevation Balancing Tier** Release 8.23 maf; if Lake Mead <1,075 feet, balance contents with a minimum/maximum release of 7.0/9.0 maf	**14.65–18.36** (2008–2026)
3,575	**Lower Elevation Release Tier** Set initial release: 6.0 maf; adjust releases based on the April Lake Powell end-of-water-year elevation projection: ≥3,575 feet, release 8.23 maf <3,575 feet AND ≥3,550 feet, release 7.48 maf <3,550 feet AND ≥3,525 feet, release 7.0 maf <3,525 feet AND ≥3,500 feet, maintain release of 6.0 maf <3,500 feet, then reduce releases (gains equals losses) such that Lake Powell ends the operating year at 3,500 feet	**8.90**
3,500	**Protection Level** <3,500 feet, in any month, reduce releases (gains equals losses) such that Lake Powell ends the operating year at 3,500 feet	**4.22**
3,370		**0**

*Active storage values have been updated from 2007 based on the 2018 bathymetry.

Figure C-2
Mean, Minimum, and Maximum Monthly Flows under LTEMP in an 8.23-maf Year



Hourly and daily releases would follow LTEMP parameters, so long as sufficient water is available from the annual release. If sufficient water is not available from the annual release to meet hourly and daily LTEMP release parameters, hourly and daily releases would follow the base operation daily and nightly minimum flows (8,000 cubic feet per second [cfs] and 5,000 cfs, respectively), for as long as possible. If sufficient water is not available from the annual release to support the base operation nightly minimum flow of 5,000 cfs, hourly and daily releases would be consistent with the run of the river[3] to match Lake Powell inflows consistent with protecting an elevation of 3,500 feet at Lake Powell.

Lower Elevation Release Tier

When the projected January 1 Lake Powell elevation is below 3,575 feet, an initial annual release in the amount of 6.0 maf would be set from Lake Powell. Adjustments to the annual release may then be made based on the April 24-Month Study, as outlined below.

- If the April 24-Month Study projects the end-of-water-year elevation to be at or above 3,575 feet, an adjustment would be made to release 8.23 maf from Lake Powell.

[3] In a general sense, "run of the river" means the inflow equals the outflow, adjusted for operational considerations, such as evaporation, seepage, and release capacity.

- If the April 24-Month Study projects the end-of-water-year elevation to be below 3,575 feet and at or above 3,550 feet, an adjustment would be made to release 7.48 maf from Lake Powell.
- If the April 24-Month Study projects the end-of-water-year elevation to be below 3,550 feet and at or above 3,525 feet, an adjustment would be made to release 7.0 maf from Lake Powell.
- If the April 24-Month Study projects the end-of-water-year elevation to be below 3,525 feet and at or above 3,500 feet, the release of 6.0 maf from Lake Powell would be maintained.
- If the April 24-Month Study projects the end-of-water-year elevation to be below 3,500 feet, the dam would be operated to maintain an elevation of at least 3,500 feet. Additionally, up to 6.0 maf would be released over the year with a goal of maintaining LTEMP minimum flows subject to run-of-the-river conditions, operational constraints, and prudent operations as determined by Reclamation.

Protection Level

If, in any month, Lake Powell's elevation is below 3,500 feet, the Lake Powell release would be set to maintain or increase the elevation with a maximum release of 6.0 maf; the goal would be to maintain LTEMP minimum flows subject to run-of-the-river conditions, operational constraints, and prudent operations as determined by Reclamation.

C.2.3 Implementation of Guidelines

The provisions for a mid-year review are the same as those under the No Action Alternative except revisions to shortages associated with Lake Mead elevation determinations in the mid-year review can be revised to allow for either further reduced deliveries or additional deliveries.

C.3 Action Alternative 2

This alternative describes a set of actions adopted pursuant to Secretarial authority under applicable federal law. Unlike current operations that were developed, and are being implemented, pursuant to basin-wide consensus (for example, the 2007 Interim Guidelines and the 2019 DCPs), Action Alternative 2 models changes to operations for both Glen Canyon Dam and Hoover Dam as developed by Reclamation. Action Alternative 2 models releases between 6.0 maf and 8.23 maf from Lake Powell when it is below 3,575 feet, with potentially lower releases to preserve an elevation of 3,500 feet and assumes additional inflow to Lake Powell pursuant to the 2019 DCPs.

Action Alternative 2 includes assumptions for reduced releases from Glen Canyon Dam and additional Lower Basin shortages that are not based exclusively on the concept of priority. While both the 2007 Interim Guidelines and the 2019 DCPs encompass reductions that reflect the priority system, the additional reductions identified in Action Alternative 2 for the remainder of the interim

period would be distributed in the same percentage across all Lower Basin water users.[4] [5] Total additional shortage volumes for the Lower Basin are the same under Action Alternative 2 as under Action Alternative 1.

As under Action Alternative 1, Action Alternative 2 models progressively larger Lower Basin reductions as Lake Mead's elevation declines and models larger Lower Basin reductions in 2025–2026 as compared with 2024. The total shortages and DCP contributions in 2024, as modeled, are limited to 2.083 maf; this is because this is the maximum volume analyzed in the 2007 FEIS. Working within this range of previously analyzed impacts will facilitate completing this SEIS process in the time available in advance of the 2024 operating year. Delaying operational decisions to perform additional analyses would not meet the express purpose of and need for this action.

This alternative includes actions and modeling assumptions that have precedent in actions previously undertaken by Reclamation under applicable federal law in both the Upper Basin (2021–2022) and Lower Basin (see the 1964 Determination by Secretary Udall to impose equivalent percentile reductions in light of reduced flows from Glen Canyon Dam). The goal is to operate Colorado River system reservoirs in a manner that ensures continued operations in a prudent manner throughout a range of projected future hydrologic conditions.

For all operations, including, but not limited to when Lake Powell is approaching 3,500 feet or when Lake Mead is approaching 950 feet, the Secretary reserves the right to operate Reclamation facilities to address extraordinary circumstances, as described in Section 7(D) of the 2007 Interim Guidelines, including "operations that are prudent or necessary for safety of dams, public health and safety, other emergency situations, or other unanticipated or unforeseen activities arising from actual operating experience."

C.3.1 Shortage Guidelines

As stated above, total additional shortage volumes for the Lower Basin are the same under Action Alternative 2 as under Action Alternative 1. The additional shortage volumes identified in **Table C-1** and **Table C-3** for calendar years 2024 and 2025–2026, respectively, would be achieved by a reduction of available Lower Basin annual consumptive use, distributed in the same percentage across all Lower Basin water users at the specified Lake Mead elevations. The distribution of reductions as modeled in Action Alternative 2 is based on each user's consumptively used water in 2021, as reported in Reclamation's final Colorado River Accounting and Water Use Report: Arizona, California, and Nevada prepared pursuant to Article V of the Supreme Court's Decree in *Arizona v. California* (as adjusted for conservation).

[4] Entities holding an entitlement to Mainstream water under (a) the Consolidated Decree, (b) a water delivery contract with the United States through the Secretary, or (c) a reservation of water by the Secretary.

[5] For example, if the additional shortage amount is 1 maf, the percentage of additional shortage volume is calculated by dividing 1 maf by 7.5 maf, which equals 13 percent. Then, a 13 percent additional reduction is modeled for each Lower Basin water user based on current water use.

Table C-5 displays the percentage of the additional shortage volumes at specified Lake Mead elevations and the distribution for each Lower Division State as modeled in Action Alternative 2. Reclamation may consider additional shortages in Shortage Condition Years 2025 and 2026 (see **Table C-3**). This consideration would occur as part of the future analysis referenced in **Section 1.2** before the 2025 operating year operating condition determination.

Figure C-1 shows a graphical view of Lower Basin shortages and contributions from the 2007 Interim Guidelines and 2019 DCPs plus additional shortages modeled under Action Alternative 2.

Like Action Alternative 1, whenever Lake Mead's content is projected to be below an elevation of 1,000 feet, based on the January 1 projection or a mid-year review, additional reductions may be needed to protect the minimum power pool (elevation 950 feet) and to reduce the risk of declining to dead pool (elevation 895 feet).

Table C-5
2024 Lower Division States' Shortages and DCP Contributions by State, Action Alternative 2 (2024)

Lake Mead Elevation (feet)	2007 ROD Shortages + 2019 DCP Contributions (1,000 af)				2024 Additional Shortage* (1,000 af)					2024 Total Shortage + Contributions (1,000 af)			
	AZ	NV	CA	Total	Percentage Additional Reduction**	AZ	NV	CA	Total	AZ	NV	CA	Total
1,090 – >1,075	192	8	0	200	2.67%	75	8	117	200	267	16	117	400
1,075 – 1,050	512	21	0	533	7.11%	199	21	313	533	711	42	313	1,066
<1,050 – >1,045	592	25	0	617	8.23%	230	25	362	617	822	50	362	1,234
1,045 – >1,040	640	27	200	867	11.56%	324	35	509	867	964	62	709	1,734
1,040 – >1,035	640	27	250	917	15.55%	435	47	684	1,166	1,075	74	934	2,083
1,035 – >1,030	640	27	300	967	14.88%	417	45	655	1,116	1,057	72	955	2,083
1,030 – 1,025	640	27	350	1,017	14.21%	398	43	625	1,066	1,038	70	975	2,083
<1,025 – 1,000	720	30	350	1,100	13.11%	367	39	577	983	1,087	69	927	2,083
<1,000 – 975	720	30	350	1,100	13.11%	367	39	577	983	1,087	69	927	2,083
<975 – 950	720	30	350	1,100	13.11%	367	39	577	983	1,087	69	927	2,083
<950	720	30	350	1,100	13.11%	367	39	577	983	1,087	69	927	2,083

*The additional shortage volumes decrease at elevation 1,025 feet because the shortages under the 2007 Interim Guidelines increase by the same amount. Therefore, the additional shortage amounts necessary to get to the 2.083 maf total are lower.
**Percentage of 2021 consumptive use

C.3.2 Coordinated Reservoir Operations

The modifications to annual Lake Powell releases and operational tiers are the same as those under Action Alternative 1.

C.3.3 Implementation of Guidelines

The provisions for a mid-year review are the same as those under Action Alternative 1.

Appendix D

CRMMS Model Documentation

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Appendix D. CRMMS Model Documentation

D.1 Introduction

Reclamation's CRMMS for the Basin is a Basin-wide operations model used to evaluate future system conditions for out to 5 years into the future. Specifically, the June 2023 CRMMS version is used for hydrologic modeling for this SEIS. This appendix provides a detailed overview of the model and its components, as well as the reservoir operations simulated in the model.

Reclamation uses two primary Basin-wide modeling and decision support tools: CRMMS and the Colorado River Simulation System (CRSS). CRMMS is run in two modes, the 24-Month Study Mode and the Ensemble Mode. The CRMMS 24-Month Study Mode is used to produce the 24-Month Study and the Annual Operating Plan. The 24-Month Study is an operational model with a 2-year outlook that uses a single most probable inflow forecast (updated monthly) provided by the National Weather Service's Colorado Basin River Forecast Center (CBRFC). The 24-Month Study is limited in its ability to incorporate hydrologic uncertainty because future reservoir operations must be input manually. Additionally, CRMMS can be run in Ensemble Mode to produce 1- to 5-year probabilistic projections of Basin conditions. CRMMS uses the CBRFC's Ensemble Streamflow Prediction (ESP) forecast (updated monthly) to provide more information about the risk and uncertainty for operations.

CRSS, which is used in long-term planning studies (for example, the 2007 FEIS) and the Colorado River Basin Water Supply and Demand Study), is a planning model that simulates Basin conditions decades into the future. Although CRSS accounts for hydrologic uncertainty in its ability to simulate hundreds of future hydrologic scenarios, it is limited in its ability to incorporate real-time forecasts and operations.

The CRMMS Ensemble Mode (referred to as CRMMS for the remainder of the appendix) provides probabilistic information about the uncertainty associated with Basin reservoir operations and future states of the system in the 1- to 5-year time frame. By supplementing the most probable projection of Basin conditions developed in the 24-Month Study, CRMMS provides a wider range of information for planning, risk analysis, and operational decision-making in the short- to mid-term planning horizons.

D.2 Overview

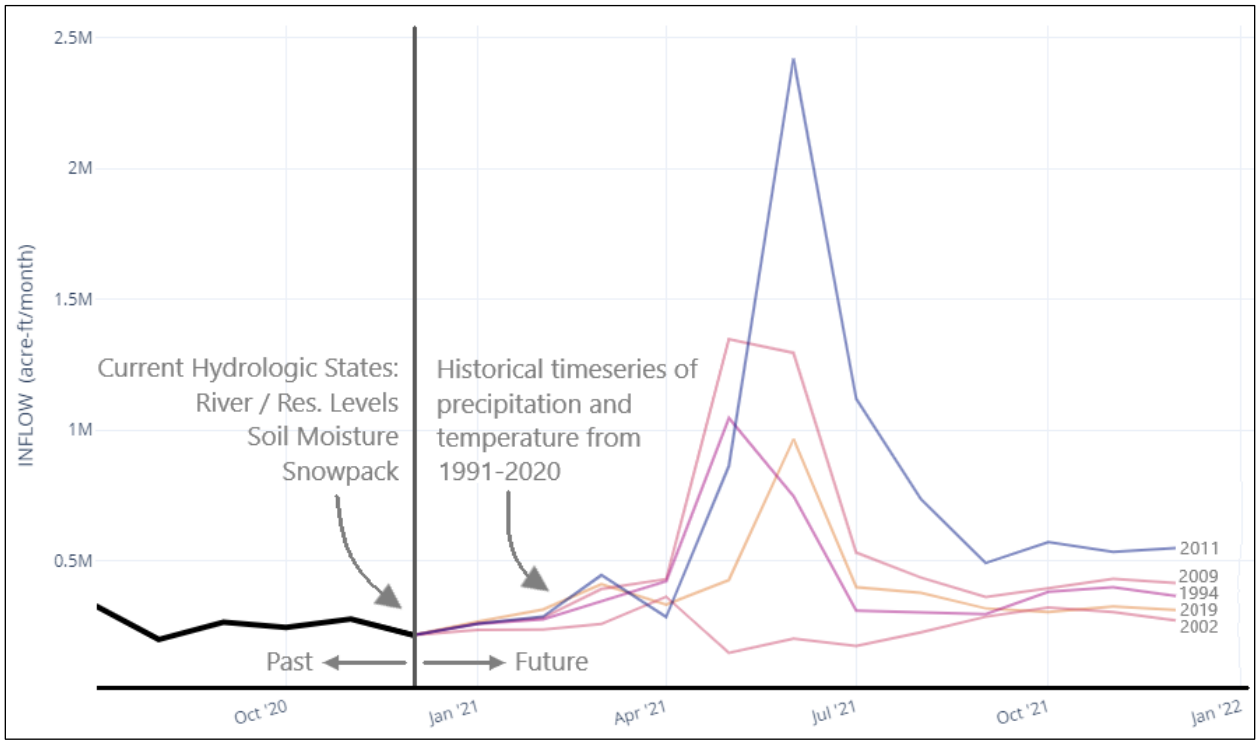
CRMMS is implemented in the commercial river modeling software called RiverWare™ developed by the Center for Advanced Decision Support for Water and Environmental Systems at the University of Colorado Boulder. Reclamation's Upper and Lower Basin Regions update and maintain the models continually, including review of model outputs.

The Basin-wide model simulates the operation of the major reservoirs on the Colorado River system and provides information regarding the projected future state of the system on a monthly basis. Output variables include the volume of water in storage, reservoir elevations, releases from the dams, energy generation, streamflow, and diversions to and return flows from water users throughout the system. Input data include physical parameters (such as individual reservoir storage capacity, evaporation rates, and reservoir release capabilities), initial reservoir conditions, and the depletion schedules for entities in the Lower Division States and for the United Mexican States (Mexico).

Upper Basin depletion schedules are not explicitly modeled in CRMMS; this is because the unregulated streamflow forecasts provided by the CBRFC include the impact of most Upper Basin depletions, except for three diversions: Gunnison Tunnel, Azotea Tunnel, and the Navajo Indian Irrigation Project (NIIP), which are individually input. These simulations use a mass balance (or water budget) calculation, which accounts for all water entering, stored in, and leaving the system. CRMMS contains a modeling "rule set," which simulates how water is released and delivered under various hydrologic conditions with the aim of simulating actual operations.

CRMMS provides information about risk and uncertainty for operations within a 1- to 5-year planning horizon. CRMMS uses an ensemble of unregulated streamflow forecasts developed by the CBRFC using ESP forecasts. **Figure D-1** depicts an example of ESP forecasts of future potential hydrologic inflows.

Figure D-1
Process for Developing ESP Forecasts



Source: Reclamation 2022e

D.2.1 Model Simulations

CRMMS simulates the operations of nine reservoirs in the Upper Basin, three reservoirs in the Lower Basin, river flows, energy generation, and diversions throughout the Basin. A description of each reservoir, the drivers of operation, and how reservoir operations are modeled in CRMMS are discussed in **Sections D.5** through **D.8**.

In understanding how CRMMS simulates operations, it is helpful to first understand the modeling process used to produce the 24-Month Study, which CRMMS attempts to replicate. To produce the 24-Month Study, Reclamation modelers first manually set releases for the reservoirs at the Upper Basin headwaters (**Table D-1**). Once operations are set for reservoirs farthest upstream, operations for the next downstream reservoirs can be entered. Information about upstream reservoir operations is required before operations can be set for the downstream reservoirs; this is because a full year of projected regulated inflow is needed to plan the reservoir releases at those downstream reservoirs. Additionally, operations for Lake Powell and Lake Mead are frequently set in an iterative manner, as Lake Powell and Lake Mead operations are coordinated based on their respective releases and resulting elevations and storages.

To simulate operations in CRMMS in a manner similar to the manual process used in producing the 24-Month Study, CRMMS takes advantage of a RiverWare feature called "run cycles." By using run cycles, RiverWare has the capability of cycling through the simulation (from the first time step to the last time step) multiple times during the run. With the aid of rule logic, CRMMS uses four run cycles to solve or "operate" the reservoirs from the Upper Basin headwaters downstream through the Lower Basin. **Table D-1** shows which reservoirs and outflows are solved within each run cycle. To initiate the model run for each year of the model run duration, Lower Basin depletion schedules are set with a default assumption of "normal condition" so that the entire Basin will solve when the rule logic solves for Lake Powell. Lower Basin Shortage and Surplus are assessed and applied in later run cycles; this is similar to the iterative process completed manually in the production of the 24-Month Study.

Table D-1
How Run Cycles Solve Reservoir Operations in CRMMS

Run Cycle	Operations Solved
1	Upper Basin headwater reservoirs: Taylor Park, Vallecito, and Fontenelle; Initial Lower Basin diversions and Lake Mead outflow
2	Additional Upper Basin reservoirs: Flaming Gorge, the Aspinall Unit, and Navajo
3	Lake Powell, Lake Mead, and the remainder of the Lower Basin (initial Lake Mead outflow was solved in run cycle 1; the flood control, surplus, shortage, and hydrologic demand variability are first solved in run cycle 3)
4	Lake Powell, Lake Mead, and the remainder of the Lower Basin may resolve again (Lake Powell releases are fine tuned to achieve balancing when appropriate, and Lower Basin operations are adjusted, if necessary, after Lake Powell releases have been modified)

An additional feature of CRMMS is that the model run duration period changes depending on the model run's initial time step. The model run duration ranges from 60 to 68 months in an ensemble run. Extending the length of the model run is required in the months of February through September to complete Lake Powell operations for the entire operating year (October through September) in the last year of the model run. Each model run's duration is specified in **Table D-2**. The modeling analysis for the SEIS uses the June 2023 version of CRMMS, but it limits the analysis period to June 2023–December 2026.

Table D-2
Model Run Duration for Ensemble Model Runs

Initial Time Step (Month)	Ensemble Run Duration (Months)
January	60
February	68
March	67
April	66
May	65
June	64
July	63
August	62
September	61
October	60
November	60
December	60

D.2.2 Model Uncertainty

CRMMS projections are subject to multiple sources of uncertainty. One source is the model, which is a simplified representation of a complex system. Another component of uncertainty is the need to estimate physical processes, such as reservoir evaporation and transpiration from plants. The most impactful source of uncertainty is the future itself; models rely on assumptions about how the hydrology, water demand, and policy and operations will unfold. Reclamation works with stakeholders and scientists to develop the best modeling practices and most appropriate assumptions in light of the purpose of the model. It is important to understand the purpose, approach, and assumptions associated with projections and their inherent uncertainty to properly interpret the information they provide.

Projections are most sensitive to assumptions about future hydrology, and future flows are highly uncertain. Assumptions about future hydrology can produce very different pictures of risk. Using ESP, CRMMS generates a wide range of hydrologic possibilities based on an assumption that the future precipitation and temperature will be similar to those experienced during the recent 30 years (1991–2020); this allows an evaluation of the Proposed Action under a wide range of future flows.

Projections farther in the future have more uncertainty. This is apparent when comparing the different ranges of possible conditions in the next 1 to 5 years. As time horizons extend and

uncertainty increases, projections of statistics-based measures, such as risks of certain system conditions, become less reliable as representations of the true probabilities that specific events may occur. All statistics calculated reflect the hydrologic scenarios and other assumptions used in modeling for this SEIS; the statistics are not intended to suggest actual probabilities of any events occurring; however, it is meaningful to compare statistics across alternatives to differentiate performance.

D.3 Hydrology

To simulate reservoir operations for up to 5 years, a hydrologic forecast of 60–68 months at 12 Upper Basin forecast points and 7 Lower Basin forecast points must be input into the model. The Upper Basin hydrology inputs are unregulated inflow forecasts for each forecast point. Unregulated flow is the forecasted flow that would arrive at a specific point if there were no dams upstream of that point. The total unregulated inflow for each forecast point includes the entire flow from the Basin upstream from that point. In other words, each downstream forecast point reflects the sum of the unregulated inflows from all forecast points above it in the Upper Basin.

Reclamation develops the Lower Basin hydrology inputs and generates them using 30 years of calculated historical intervening flows. The 30-year period of historical flows matches the CBRFC's 30-year calibration period (currently 1991 through 2020) to provide consistency in the periods of record used to produce flow assumptions for the Upper and Lower Basin portions of the model. Historical, intervening flows in the Lower Basin are calculated based on a mass balance approach, as discussed in **Section D.3.2**. Intervening flows for this purpose are defined as the amount of flow entering the system between the upstream point and the downstream point.

D.3.1 Upper Basin Hydrology

The CBRFC provides ESP forecasts at 12 Upper Basin forecast points (**Table D-3**). The ESP method generates multiple time series (that is, traces) of forecasted streamflows. Forecasts are created using the Sacramento Soil Moisture Accounting hydrologic model, which is initialized with current Basin conditions for soil moisture and snowpack and forced with a set of historical time series of precipitation and temperature that match the model calibration period (currently 1991 through 2020). This process results in a 30-member ensemble for monthly streamflow forecasts based on current Basin conditions and temperature and precipitation that match the 1991–2020 climatological period.

Table D-3
Upper Basin Forecast Points

Fontenelle Inflow
Flaming Gorge Unregulated Inflow
Yampa River Inflow
Taylor Park Inflow
Blue Mesa Unregulated Inflow
Crystal Unregulated Inflow
Morrow Point Unregulated Inflow
Gains Crystal to Grand Junction
Vallecito Unregulated Inflow
Animas River Inflow
Navajo Unregulated Inflow
Powell Unregulated Inflow

D.3.2 Lower Basin Hydrology

For modeling purposes in CRMMS, the Lower Basin is the portion of the model below the Lees Ferry gage. Although the intervening flows between Glen Canyon Dam and the Lees Ferry gage are physically located in the Upper Basin above the Lee Ferry Compact Point, the methodology used to project these flows matches the methodology used to project the Lower Basin inflows; therefore, flows at the Lees Ferry gage are included in this section. The hydrologic inputs for the Lower Basin are intervening flows (**Table D-4**), which may be positive, representing a gain in the reach (e.g., local inflows), or negative, representing a loss in the reach (e.g., losses to ground water, evapotranspiration, or other processes).

Table D-4
Lower Basin Intervening Flow Points

Glen Canyon Dam to Lees Ferry
Lees Ferry to the USGS gage at Grand Canyon
USGS gage at Grand Canyon to Hoover Dam
Hoover Dam to Davis Dam
Davis Dam to Parker Dam
Parker Dam to Imperial Dam
Imperial Dam to Northerly International Boundary with Mexico

The intervening inflows are the estimated volumes calculated by Reclamation's Lower Colorado Gain-Loss Model. This method calculates the intervening inflows using a mass balance approach. CRMMS uses the calculated intervening inflow values from the same 30-year period for which the CBRFC produces forecast traces (1991 through 2020).

Just as the model rotates through Upper Basin inflow traces corresponding to a particular year in the 30-year calibration period, the model also rotates through intervening flows in the Lower Basin

corresponding to the same year. For example, the Upper Basin inflow forecast corresponding to the 1991 trace is generated from the temperature and precipitation from 1991 through 1995. In this 1991 trace, the intervening inflows for all seven reaches below Glen Canyon Dam are the historical, calculated, intervening inflows from 1991 through 1995.

D.3.3 Hydrology Used in CRMMS SEIS Modeling

The hydrologic scenarios used in the SEIS are derived from the June 2023 ESP Upper Basin forecast and associated Lower Basin intervening flows. Three sets of ESPs are used in the SEIS modeling:

- 100 percent ESP: There is no adjustment to the streamflow forecasts.
- 90 percent ESP: Streamflow forecasts are reduced by 10 percent.
- 80 percent ESP: Streamflow forecasts are reduced by 20 percent.

ESP forecasts are adjusted at each forecast location by reducing the monthly streamflow forecast by the desired percentage. The following equation was used to reduce each month's streamflow forecast:

$$AdjustedMonthlyStreamflow_i = MonthlyStreamflow_i - |MonthlyStreamflow_i| \times PercentReduction$$

where, *PercentReduction* is the percent reduction (i.e., 0.1 or 0.2 for the 90 percent ESP and 80 percent ESP, respectively), and *i* is a single forecast location for all locations described in **Sections D.3.1** and **D.3.2**.

The equation allows for the adjustment of both negative and positive forecasts.

The three sets of ESPs—100 percent ESP, 90 percent ESP, and 80 percent ESP—are combined into a 90-member hydrologic scenario for SEIS analysis purposes. The three sets of ESPs allow for an analysis of a wider range of low-flow hydrologic scenarios beyond those experienced during the recent 30 years (1991–2020). It is possible, however, that future flows may include periods of wet or dry conditions that are outside the 90-member scenario sequences analyzed.

D.4 Initial Reservoir Conditions

CRMMS was initialized with the observed May 2023 end-of-month reservoir conditions shown in **Table D-5**.

Table D-5
End-of-Month Reservoir Conditions Used as Initial Conditions

Reservoir	Elevation (feet above mean sea level [msl])	Storage (af)
Fontenelle	6,494.66	249,866
Flaming Gorge	6,020.21	2,917,394
Taylor Park	9,316.35	80,454

Reservoir	Elevation (feet above mean sea level [msl])	Storage (af)
Blue Mesa	7,491.44	588,968
Morrow Point	7,153.72	111,993
Crystal	6,751.16	16,449
Vallecito	7,651.55	90,920
Navajo	6,063.70	1,340,268
Powell	3,561.42	7,887,844
Mead	1,054.28	7,995,261
Mohave	641.83	1,666,824
Havasu	446.26	547,344

D.5 Reservoirs Upstream of Lake Powell

Nine Upper Basin reservoirs are simulated in CRMMS. Each of the nine Upper Basin reservoirs included in the model has an individual operation plan. Some facilities are operated to meet storage or elevation targets, while others feature environmentally regulated, controlled, consistent releases. Within the model, each reservoir has a set of rules to guide the specific operations. The model solves by using the logic in those operating rules. The following briefly describes the various Upper Basin reservoirs along with a high-level description of the logic in RiverWare for simulating operations within the Upper Basin. The operations of the Upper Basin reservoirs above Lake Powell are modeled the same for the No Action Alternative and the Proposed Action.

In a rule-based model, such as CRMMS in Ensemble Mode, general assumptions must be made for the model to solve. The rules developed for CRMMS are, ideally, the best representation of operations that can be projected. In practice, however, there are sometimes differences between the projected operations produced by the model and actual operations. For example, many reservoirs in the Upper Basin are operated following the principles of adaptive management. As such, operations may be altered to meet various objectives of the reservoirs' adaptive management work groups on an ad hoc or experimental basis. Such ad hoc or experimental operations cannot be known in advance, within the 5-year model outlook. As such, CRMMS Ensemble Mode projections may differ from actual operations, even under similar hydrologic conditions.

D.5.1 Fontenelle Reservoir

Fontenelle Reservoir is on the Green River about 24 miles southeast of La Barge, Wyoming. Fontenelle Reservoir is operated to meet various target elevations throughout the year while staying within practical and authorized limits.

D.5.2 Flaming Gorge Reservoir

Flaming Gorge Reservoir is on the Green River about 32 miles downstream of the Utah-Wyoming border and upstream of the confluence with the Yampa River. The operations of Flaming Gorge Reservoir meet the requirements detailed in the 2006 Record of Decision for the Operation of Flaming Gorge Dam Final Environmental Impact Statement (2006 Flaming Gorge ROD; Reclamation 2006a) that were designed to achieve the authorized purposes of the Colorado River

Storage Project Act, while addressing environmental requirements. The 2006 Flaming Gorge ROD outlines the operational guidelines of Flaming Gorge and implements, to the extent possible, recommendations to assist in the recovery of four endangered fish species, outlined in the 2000 Flow and Temperature Recommendations for Endangered Fish in the Green River Downstream of Flaming Gorge Dam (Muth 2000).

Flaming Gorge operations are governed by the April through July unregulated inflow into the reservoir, which determines the corresponding hydrologic classification, spring peak, and base flow targets from the 2006 Flaming Gorge ROD (Reclamation 2006a) for the year. The April through July releases are modeled at the daily time step in CRMMS to approximate the sub-monthly component of the spring peak targets. The model logic determines typical daily operations from April through July before summing to a monthly release. During the March to April transition period, Flaming Gorge operations try to achieve a May 1 storage target. Actual annual operations at Flaming Gorge are determined in a consultation process with other agencies. The CRMMS Ensemble Mode cannot model these adaptive management decisions; therefore, model results do not include possible future adaptive management decision changes to the logic described above.

D.5.3 Taylor Park Reservoir

Taylor Park Reservoir is on the Taylor River, a tributary of the Gunnison River on the western slope of Colorado's Rocky Mountains. Taylor Park Reservoir is operated with a rule curve to meet various target elevations throughout the year, while staying within practical and authorized limits.

D.5.4 Aspinall Unit Reservoirs – Blue Mesa, Morrow Point, and Crystal

The Aspinall Unit consists of three reservoirs—Blue Mesa, Morrow Point, and Crystal—in series along the Gunnison River in western Colorado. The operations of the Aspinall Unit meet the requirements detailed in the April 2012 Record of Decision for the Aspinall Unit Operations Final Environmental Impact Statement (2012 Aspinall ROD; Reclamation 2012) and the decree quantifying the Federal Reserved Water Right for the Black Canyon of the Gunnison, which specify the spring peak outflow hydrographs and base flows for the rest of the year based on the hydrologic conditions upstream of Blue Mesa Reservoir. The 2012 Aspinall ROD provides specifications to avoid jeopardizing the continued existence of fish listed under the Endangered Species Act and to ensure the dam's operations do not result in the destruction or adverse modification of critical habitat in the Gunnison River.

Aspinall Unit operations are governed by the April through July unregulated inflow into the reservoir, which determines spring peak and base flow targets for the rest of the year based on the hydrologic conditions above Blue Mesa Reservoir. CRMMS approximates daily flow targets in the 2012 Aspinall ROD and Federal Reserved Water Right for the Black Canyon of the Gunnison by first modeling typical daily operations for both the spring and baseflow periods and then summing to a monthly release. Morrow Point and Crystal Reservoirs are modeled to maintain elevation targets of 7,153.73 and 6,753.04 feet, respectively.

D.5.5 Vallecito Reservoir

Vallecito Reservoir is on the Pine River, which flows into the San Juan River. The reservoir is 18 miles northeast of Durango, Colorado. Vallecito Reservoir is operated with a rule curve to meet various target elevations throughout the year, while staying within practical and authorized limits.

D.5.6 Navajo Reservoir

Navajo Reservoir is on the San Juan River above the confluence with the Animas River. The reservoir is operated to meet environmental requirements outlined in the July 2006 Record of Decision for the Navajo Reservoir Operations, Navajo Unit-San Juan River New Mexico, Colorado, Utah Final Environmental Impact Statement (Reclamation 2006b). Navajo Reservoir also provides for the diversion of NIIP water from Navajo Reservoir, and other municipal and industrial uses throughout the San Juan Basin. The minimum active storage at Navajo Reservoir is at 5,990 feet; at that point, the NIIP can no longer divert water.

Navajo Reservoir operations are modeled to first meet the environmental baseflow requirements at downstream gages stated in the July 2006 Record of Decision for the Navajo Reservoir Operations, Navajo Unit-San Juan River New Mexico, Colorado, Utah Final Environmental Impact Statement (Reclamation 2006b); because of the CRMMS spatial scale, it is assumed that all flow targets are for the San Juan River near Farmington, New Mexico. If available additional water is released as a spring peak, a spring release pattern is selected to bring Navajo Reservoir closest to the September 30 storage target, while staying within practical and authorized limits, including maintaining NIIP diversions. If the reservoir pool elevation is projected to go below 5,990 feet, the minimum elevation for NIIP diversions, the outflow, and NIIP diversions are proportionally reduced.

D.5.7 DROA Year 2022 Contribution Assumptions

The CRMMS modeling assumes no DROA releases, which is consistent with the June 2023 CRMMS simulation. The DROA releases from Flaming Gorge totaled 463,000 af for May 2022 through March 2023.[1] Starting March 2023, recovery of DROA releases began. By June 2023, 178,000 af had been recovered at Flaming Gorge, which was reflected in the initial reservoir conditions. CRMMS modeling does not include any assumptions regarding future DROA releases. Reclamation will attempt to maximize DROA recovery in the Upper Initial Units in water year 2023 and through April 2024.

D.6 Lake Powell Operation

Lake Powell is the most downstream reservoir in the Upper Basin; it is impounded by Glen Canyon Dam. Near Page, Arizona, Glen Canyon Dam is 17 miles upstream of Lee Ferry, the delineation point between the Upper and Lower Basins.

In CRMMS, Lake Powell operations logic calculates the annual operating year release, followed by disaggregating the annual release to monthly releases. The sections below summarize these operations. **Section D.6.1** describes modeling assumptions common to all alternatives. **Section**

[1] The projected 500,0000 af DROA release was reduced on March 7, 2023, and recovery began in March 2023.

D.6.2 describes model assumptions for Lake Powell operating tiers used in the No Action Alternative and the Proposed Action.

D.6.1 Assumptions Common to All Alternatives

CRMMS solves for Lake Powell operating tiers in CRMMS run cycles 3 and 4. In August, operations of Lake Powell are set for the entire following operating year (that is, October through September). An initial operating year release of 8.23 maf is used to solve for the end-of-calendar-year pool elevation, which is used to determine the operating tier and annual operating year release volume. The annual release is then disaggregated into monthly releases using the Long-term Experimental and Management Plan release patterns. The Lake Powell assumed monthly releases for CRMMS are in **Table Attachment D-1**.

The monthly releases solved using **Table Attachment D-1** can be constrained due to physical limitations at Glen Canyon Dam. Water can be released through the powerplant turbines until the pool elevation drops below 3,490 feet. Once Lake Powell is below 3,490 feet, releases are made through the river outlet works. There are four river outlet works at Glen Canyon Dam. The capacity of the river outlet works varies with the elevation of Lake Powell; the higher the pool elevation, the higher the potential release through the river outlet works. CRMMS computes the maximum monthly release based on the Lake Powell elevation using **Table D-6** and interpolates for the capacity between elevations listed in **Table D-6**. For the SEIS modeling, three out of four river outlet works are assumed available for use at any given time; this is because of the need for periodic inspections and any associated maintenance activities. Reclamation believes this is a reasonable estimation given the historical and future operations and maintenance requirements for the river outlet works.

Table D-6
CRMMS Modeled River Outlet Works' Capacity by Lake Powell Elevation

Lake Powell Elevation	Capacity (1 river outlet work)		Capacity (3 river outlet works)	
feet	cfs	af/month*	cfs	af/month*
3,490	3,660	225,045	10,980	675,134
3,480	3,620	222,585	10,860	667,755
3,470	3,520	216,436	10,560	649,309
3,460	3,380	207,828	10,140	623,484
3,450	3,140	193,071	9,420	579,213
3,440	2,860	175,855	8,580	527,564
3,430	2,560	157,408	7,680	472,225
3,420	2,200	135,273	6,600	405,818
3,410	1,760	108,218	5,280	324,655
3,400	1,200	73,785	3,600	221,355
3,390	800	49,190	2,400	147,570
3,380	400	24,595	1,200	73,785
3,370	0	0	0	0

* Computed using 31 days per month

D.6.2 No Action Alternative

Lake Powell operating tiers are determined based on the projected end-of-calendar-year pool elevation at Lake Powell. For operating year 2023, the August 2022 24-Month Study projected the January 1, 2023, effective[2] pool elevation to be less than 3,525 feet, which results in 2023 operations being governed by the Lower Elevation Balancing Tier. CRMMS rules are then used to solve for the 2023 annual release in the Lower Elevation Balancing Tier.

For operating years beyond 2023, CRMMS will solve for the Lake Powell operating tier and annual release for the entire operating year in August. The first step of solving for the Lake Powell operating tier is to set the annual release to 8.23 maf. This allows CRMMS to solve for Lake Powell releases for the entire operating year and to solve for storage and other parameters, since CRMMS solves for the inflow in run cycle 2. This includes the end-of-calendar-year pool elevation, which is used to set the Lake Powell operating tier.

CRMMS solves for the Lake Powell operating tier and operating year release as follows using the projected end-of-calendar-year pool elevation:

- If the projected Lake Powell end-of-calendar-year pool elevation is greater than or equal to the equalization level (**Table D-7**), the Equalization Tier operations govern the operating year releases.
- If the projected Lake Powell end-of-calendar-year pool elevation is less than the equalization level and greater than or equal to 3,575 feet, the Upper Elevation Balancing Tier governs the operating year releases.
- If the projected Lake Powell end-of-calendar-year pool elevation is less than 3,575 feet and greater than or equal to 3,525 feet, the Mid-Elevation Release Tier governs the operating year releases.
- If the projected Lake Powell end-of-calendar-year pool elevation is less than 3,525 feet, the Lower Elevation Balancing Tier governs the operating year releases.

The annual release for each tier is described below for the No Action Alternative. The last section describes how Lake Powell operating year releases are disaggregated to a monthly scale.

[2] The reduction of releases from Lake Powell from 7.48 to 7.00 maf in operating year 2022 resulted in a reduced release volume of 0.48 maf that normally would have been released from Glen Canyon Dam to Lake Mead as part of a 7.48-maf annual release volume, consistent with routine operations under the 2007 Interim Guidelines. The reduction of releases from Glen Canyon Dam in operating year 2022 (resulting in increased storage in Lake Powell) did not affect the operation determination for 2023; it was accounted for "as if" this volume of water had been delivered to Lake Mead, which is referred to as "effective" pool elevation. In April 2023, Reclamation removed the operational neutrality of the 0.48 maf that was retained in Lake Powell under the May 2022 action, such that 2023 balancing releases are based on the projected end-of-water-year physical contents of Lake Powell and Lake Mead.

Table D-7
Lake Powell Equalization Level Table

Year	Equalization Elevation (feet)
2023	3,662
2024	3,663
2025	3,664
2026	3,666

D.6.2.1 Equalization Tier

Under the No Action Alternative, the equalization of storage between Lake Powell and Lake Mead is modeled with a rule that first calculates how much water would be released to equalize Lakes Powell and Mead. The release for equalization is computed by taking half of the difference between the predicted end-of-water-year volumes of Lake Powell and Lake Mead. Evaporation and bank storage losses at Lake Powell and Lake Mead are estimated in the calculation. The equalization release is then constrained by choosing the minimum of the equalization release, the release to take Lake Mead to 1,105 feet, and the release to take Lake Powell to 20 feet below the equalization level. The rule then sets the Lake Powell operating year release to the maximum of the constrained equalization volume and an 8.23-maf release. Monthly releases from Lake Powell are then calculated for the operating year using **Table Attachment D-1**.

After Lake Powell and Lake Mead have both resolved, a higher-priority rule refines the equalization release. This rule is also used to refine the Upper Elevation Balancing Tier equalization releases. The rule calculates the volume deviation of the end-of-water-year storage at Lake Powell and Lake Mead from target levels (that is, equalization to achieve Lake Mead at 1,105 feet or to achieve Lake Powell 20 feet below the equalization level). The deviation volume then adjusts Lake Powell's release to achieve the end-of-water-year target, subject to a minimum release of 8.23 maf. This rule is allowed to iterate so that end-of-water-year target elevations are achieved to within a specified tolerance.

D.6.2.2 Upper Elevation Balancing Tier

Once it is determined that Lake Powell is starting the year in the Upper Elevation Balancing Tier, the projected end-of-water-year pool elevation at the end of the next operating year (for example, September 30, 2024, when the model has set the operating tier in August 2023) is used to determine how much water is released.

If the projected Lake Powell end-of-water-year pool elevation is above the equalization level, then an April switch to equalization is modeled, and the operating year release is set based on equalization logic (described in the previous section) and constrained to a minimum of 8.23 maf. Otherwise, if Lake Powell's projected end-of-water-year pool elevation is less than or equal to the equalization level, Lake Powell's releases are modeled consistent with the Upper Elevation Balancing constraints and depend on Lake Mead's end-of-water-year pool elevation:

- If the Lake Mead end-of-calendar-year pool elevation is greater than or equal to 1,075 feet, the operating year release necessary to balance Lake Powell and Lake Mead's end-of-water-year storage is calculated but constrained to be within the range of 8.23 to 9.0 maf.

- If the Lake Mead end-of-calendar-year pool elevation is greater than 1,075 feet, and the Lake Powell end-of-water-year pool elevation is less than or equal to 3,575 feet, the operating year release is 8.23 maf.
- If the Lake Mead end-of-calendar-year pool elevation is less than 1,075 feet, the operating year release necessary to balance Lake Powell and Lake Mead end-of-water-year storage is calculated but constrained to be within the range of 7.0 to 9.0 maf.

D.6.2.3 Mid-Elevation Release Tier

The Mid-Elevation Release Tier is modeled by first checking Lake Mead's projected end-of-calendar-year pool elevation. If the Lake Mead end-of-calendar-year pool elevation is greater than or equal to 1,025 feet, Lake Powell's operating year release is set to 7.48 maf. Otherwise, the operating year release is set to 8.23 maf.

D.6.2.4 Lower Elevation Balancing Tier

For operating years 2023 and 2024, the Lower Elevation Balancing Tier operations are modeled in a way that protects critical elevations at Lake Powell. This is done by assessing potential balancing releases in April 2023 and limiting any balancing releases (with a minimum of 7.00 maf) to protect Lake Powell from declining below an elevation of 3,525 feet at the end of December of the following year. For operating years 2025 and 2026, balancing releases are not limited to protect Lake Powell from declining below critical elevations.

In CRMMS, the Lower Elevation Balancing Tier is modeled by first setting the Lake Powell operating year release to 7.0 maf, which causes Lake Powell to resolve for monthly releases and pool elevations. Next, Lower Elevation Balancing Tier releases are calculated with different constraints, which depend on the operating year, as previously described.

- In operating years 2023 and 2024:
  - If the Lake Powell end-of-water-year pool elevation is greater than the protection threshold of 3,535 feet,[3] two potential annual releases are calculated: (1) the operating year release necessary to balance Lake Powell and Lake Mead's end-of-water-year storage; the release is calculated but constrained to be within the range of 7.0 to 9.5 maf.; and (2) the release needed so that Lake Powell's end-of-water-year pool elevation is 3,535 feet. The minimum of these two releases is used to set Lake Powell's annual release. If the end-of-water-year Lake Powell pool elevation is less than the protection threshold of 3,535 feet with a 7.0 maf release, the release is not adjusted.
- In operating years 2025 and beyond:
  - The operating year release necessary to balance Lake Powell and Lake Mead's end-of-water-year storage is calculated but constrained to be within the range of 7.0 to 9.5 maf.

D.6.2.5 Disaggregation from Annual to Monthly Release

Lake Powell operating year releases are disaggregated to monthly releases anytime the operating year release volume is set for Lake Powell. The operating year volume is used to select the closest

[3] The protection threshold of 3,535 feet was used for modeling purposes since it is the end-of-water-year elevation needed during an average year to achieve an end-of-calendar-year elevation of 3,525 feet (or higher).

operating year release pattern from **Table Attachment D-1**; for operating year releases between set values, the monthly releases are interpolated between the two columns with the closest operating year release. Except for certain circumstances, as noted below, the water year volume is preserved when interpolating monthly releases.

There are a few special cases where the monthly releases are not interpolated directly from **Table Attachment D-1**. If there is an equalization outflow in the Upper Elevation Balancing Tier, then the outflows from October until March follow a path of a 9.0-maf release and then will be either the maximum powerplant release or the remaining amount of volume to meet the equalization annual release volume. The April through September releases are calculated to attempt to release the remainder operating year release volume, while constraining releases to the powerplant capacity. If the operating year release volume is less than 8.23 maf, the release pattern is set to the 7.48-maf pattern for October through December. For January through September, the remainder of the operating year release volume is released proportional to **Table Attachment D-1**.

The disaggregated monthly releases are further constrained so that the monthly releases do not exceed what can be moved through the river outlet works. If a monthly release is constrained, the volume is tracked and is attempted to be released later in the operating year to maintain the desired operating year release, if possible.

D.6.2.6 Issue in Modeled Lake Powell Releases in the No Action Alternative

Reclamation found a minor issue with modeled Lake Powell releases under certain conditions in the No Action Alternative. The issue was due an error in calculating balancing releases when Lake Powell could not release the full target water year release volume due to bypass tube capacity constraints when Lake Powell was below minimum power pool. The issue does not affect results for any other alternatives. The issue is discussed in **Attachment D-2**.

D.6.3 Proposed Action

CRMMS solves for Lake Powell operations as described for the No Action Alternative, except for a protection-level provision described in **Section D.6.3.5**.

D.6.3.1 Equalization Tier

The Equalization Tier method for Lake Powell under the Proposed Action is identical to that under the No Action Alternative.

D.6.3.2 Upper Elevation Balancing Tier

The Upper Elevation Balancing Tier method for Lake Powell under the Proposed Action is identical to that under the No Action Alternative.

D.6.3.3 Mid-Elevation Release Tier

The Mid-Elevation Release Tier method for Lake Powell under the Proposed Action is identical to that under the No Action Alternative, except when additional adjustments are necessary to protect an elevation of 3,500 feet. See **Section D.6.3.5** for additional details on these additional adjustments.

D.6.3.4 Lower Elevation Balancing Tier

The Lower Elevation Balancing Tier method for Lake Powell under the Proposed Action is identical to that under the No Action Alternative, except when additional adjustments are necessary to protect an elevation of 3,500 feet. See **Section D.6.3.5** for additional details on these additional adjustments.

D.6.3.5 Protection Level

The Proposed Action specifies a protection level of 3,500 feet at Lake Powell such that Reclamation can make a mid-year adjustment to reduce the operating year release no less than 6.0 maf, if Lake Powell is projected to drop below 3,500 feet in the next 12 months.

In CRMMS, this is modeled by checking Lake Powell pool elevations from April through the end of the water year when Lake Powell is operating in the Mid-Elevation Release Tier or Lower Elevation Balancing Tier. If the Lake Powell pool elevation is projected to drop below 3,500 feet or is already below 3,500 feet, monthly releases will be adjusted for April through September. The monthly release will be decreased such that the Lake Powell pool elevation is maintained at or above 3,500 feet; however, it is subject to the following constraints: the minimum water year release is 6.0 maf, and the monthly releases will release a volume not less than the volume necessary to meet the minimum daily LTEMP release. If releases are adjusted in April through September and Lake Powell pool elevation increases above 3,500 feet, monthly releases can be increased to release up to the original annual release volume for the given Lake Powell operating tier.

If the protection of 3,500 feet is triggered in April, Lake Powell's release can be adjusted to protect 3,500 feet during the following water year. The same logic applies to the second water year, but releases can be adjusted starting at the beginning of the water year.

D.6.3.6 Disaggregation from Annual to Monthly Release

Lake Powell operating year releases are disaggregated to monthly releases using the same method as under the No Action Alternative.

D.7 Lake Mead Operation

Lake Mead is the uppermost reservoir in the Lower Basin. Located 35 miles southeast of Las Vegas, the 726-foot-high Hoover Dam impounds Lake Mead. In CRMMS, Lake Mead operations are modeled by solving for the Lower Basin condition, Lower Basin and Mexico diversions, and intentionally created surplus (ICS) and other conservation activity. **Section D.7.1** describes modeling assumptions common to all alternatives. **Sections D.7.2** and **D.7.3** describe Lake Mead operations for the No Action Alternative and Proposed Action, respectively.

D.7.1 Assumptions Common to All Alternatives

CRMMS solves for the Lower Basin operating condition in CRMMS run cycles 3 and 4. In August, operations of Lake Powell are set for the entire following operating year (that is, October through September). Once Lake Powell releases are set for the entire operating year, the Lower Basin condition can be solved, which occurs in the January time step. After the condition is set, depletion

schedules for the Lower Division States and Mexico may be modified in accordance with the requirements of the operating condition for the entire calendar year, based on the 2007 Interim Guidelines, 2019 DCPs, Minute 323, and system conservation agreements. Assumed ICS activity may also affect the water user depletions. Once demands below Lake Mead are calculated, Lake Mead's release is set to meet downstream demands.

For Lower Division States and Mexico use, in the first year of the model run, depletion schedules use water orders that reflect shortage conditions, Lower Basin DCP contributions, reductions under low-elevation reservoir conditions, Binational Water Scarcity Contingency Plan (BWSCP) contributions per Minute 323, and signed system conservation agreements. For the remaining years in the model run, depletion schedules reflect "normal" schedules, and represent near-term historical trends in water use. All additional reductions (2007 Interim Guidelines shortages, DCP reductions, and reductions under low-elevation reservoir conditions and BWSCP contributions per Minute 323) reduce these "baseline/normal" depletion schedules. Depletion schedules for CRMMS water users that were used in the June 2023 CRMMS modeling are summarized in **Attachment D-3**.

D.7.1.1 Lake Mead/Hoover Dam Flood Control

The Lake Mead flood control logic in CRMMS is based on the 1984 Field Working Agreement between Reclamation and the United States Army Corps of Engineers. Three flood control procedures are in effect for different times of the year. The first procedure is in effect throughout the year. Its objective is to maintain a minimum space of 1.5 maf in Lake Mead, primarily for extreme storm events. This space is referred to as exclusive flood control space and is represented by the space above elevation 1,219.6 feet. The second procedure is used during the period from January to July. The objective during this period is to route the maximum inflow forecast through the reservoir system using specific rates of Hoover Dam outflow, assuming that Lake Mead will fill to elevation 1,219.6 feet at the end of July. The third procedure is used during the space-building or drawdown period of August through December. The objective during this period is to gradually draw down the reservoir system, to meet the total system space requirements in each month in anticipation of the next year's runoff.

This logic matches the logic used in the 2007 FEIS. Given the June 2023 conditions and inflow forecast ensemble, there were no instances of simulating flood control operations in the SEIS modeling through 2026.

D.7.2 No Action Alternative

Lake Mead operations and Lower Basin conditions are modeled based on projected end-of-calendar-year pool elevation at Lake Mead.

D.7.2.1 Surplus

The Lower Basin operates in a Surplus Condition if the Lake Mead elevation is above 1,145 feet and below an elevation that would trigger space-building or flood control releases pursuant to the 1984 Field Working Agreement between Reclamation and the US Army Corps of Engineers (described in **Section D.7.1.1**).

The 2007 Interim Guidelines define two levels of Surplus. A Domestic Surplus is determined if the Lake Mead elevation is above 1,145 feet and below the elevation that triggers a Quantified Surplus. Under a Domestic Surplus, depletion schedules are modified in the Lower Division States consistent with the 2007 Interim Guidelines Section 2.B.2. A Quantified Surplus is determined if water needs to be delivered to reduce the risk of potential reservoir spills based on the 70R Strategy (see 2007 FEIS, Appendix A, Section A.6.2.4). Under a Quantified Surplus, depletion schedules are modified in the Lower Division States consistent with the 2007 Interim Guidelines Section 2.B.3.

D.7.2.2 Normal Conditions

The Lower Basin operates in a Normal Condition if the Lake Mead elevation is above 1,075 feet and below 1,145 feet. If the model determines that a Normal Condition exists, the model retains the default Normal schedules initially assigned in run cycle 1. Depletion schedules might be modified due to ICS creation or delivery logic or for DCP contributions. An ICS Surplus Condition is a type of Normal Condition that is determined when Lake Mead's elevation is above 1,075 feet and below 1,145 feet, and there is an ICS creation plan in place for at least one Lower Basin entity.

D.7.2.3 Shortage Conditions

A Lower Basin Shortage Condition is modeled if the Lake Mead elevation is less than or equal to 1,075 feet. A rule solves for the Shortage Condition in January by comparing Lake Mead's end-of-calendar-year pool elevation to defined pool elevations, as shown in **Table D-8**.

Once the Shortage Condition is set, shortage volumes (**Table D-8**) are assigned to users proportionally to a user's monthly and annual scheduled water use:

$$MonthlyShortage_i = AnnualShortage_i * \left(\frac{MonthlyWaterUse_i}{AnnualWaterUse_i}\right)$$

where *i* is an individual water user.

Diversions for water users are then adjusted with the user's monthly shortage. In Nevada, Southern Nevada Water Project (SNWP) users incur the entire shortage volume; in Arizona, the entire shortage volume is modeled to be incurred by the Central Arizona Project.

Table D-8
Lower Division State Shortage Volumes

Lake Mead Elevation (feet)	Arizona Shortage (af)	Nevada Shortage (af)	Total Shortage (af)
>1,075	0	0	0
1,075 to 1,050	320,000	13,000	333,000
<1,050 to 1,025	400,000	17,000	417,000
<1,025	480,000	20,000	500,000

D.7.2.4 Minute 323 High- and Low-Elevation Reservoir Conditions

Minute 323 defines reductions to Mexico under low-elevation reservoir conditions based on the projected Lake Mead end-of-calendar-year pool elevation. **Table D-9** shows Mexico's reductions. Adjustments to Mexico's delivery assume the same method to disaggregate the annual reduction to a monthly reduction as the adjustments due to shortage in the Lower Division States (**Section D.7.2.3**).

Table D-9
Mexico Minute 323 Reductions

Lake Mead Elevation (feet)	Mexico Reduction (af)
>1,075	0
1,075 to 1,050	50,000
<1,050 to 1,025	70,000
<1,025	125,000

Distribution of flows to Mexico under high-elevation reservoir conditions are modeled in accordance with Minute 323 Section II, when the Lake Mead end-of-calendar-year pool elevation is at or above 1,145 feet.

D.7.2.5 2019 DCPs and BWSCP

CRMMS models the 2019 DCP contributions in accordance with Exhibit 1 to the Lower Basin DCP agreement and the Minute 323 BWSCP. The contribution volumes (**Table D-10**) are based on the projected Lake Mead end-of-calendar-year pool elevation, similar to the Shortage Condition. For modeling purposes, DCP contributions can be made through conversion of existing ICS, simultaneous ICS creation and conversion to DCP-ICS, and/or reducing depletions to create system water. Additional CRMMS ICS assumptions are described in **Section D.7.2.6**.

Table D-10
2019 DCP and Minute 323 BWSCP Contribution Volumes

Lake Mead Elevation (feet)	DCP (1,000 af)			Minute 323 BWSCP (1,000 af)
	Arizona	Nevada	California	
>1,090	0	0	0	0
1,090 – 1,075	192	8	0	41
1,075 – 1,050	192	8	0	30
<1,050 – >1,045	192	8	0	34
1,045 – >1,040	240	10	200	76
1,040 – >1,035	240	10	250	84
1,035 – >1,030	240	10	300	92
1,030 – 1,025	240	10	350	101
<1,025	240	10	350	150

As previously mentioned, in the first year of the model run, depletion schedules use water orders that reflect shortage conditions, Lower Basin DCP contributions, and Minute 323 reductions and contributions. These first-year depletion schedules reflect more guidance and input from states,

water users, and Mexico than exist for the subsequent modeled years. In the subsequent years, model assumptions are developed with states, water users, and Mexico to provide a reasonable assumption for how DCP and BWSCP contributions might be made, as described below.

In Nevada, the DCP contribution is generally made by converting extraordinary conservation (EC)-ICS to DCP-ICS. If there is not enough EC-ICS available to meet the full DCP contribution, Nevada simultaneously creates EC-ICS and converts it to DCP-ICS in the year it is required. If insufficient ICS accumulation limit[4] space exists to create DCP-ICS, then contributions are made via system water.

In California, the agreement between the Metropolitan Water District of Southern California (MWD) and Coachella Valley Water District (Coachella) is modeled in CRMMS; however, the entire DCP-ICS balance in CRMMS is tracked in the MWD's ICS account. This means that CRMMS decreases Coachella's water use schedule by 7 percent of California's DCP contribution. Then, the MWD makes 100 percent of the DCP contribution by converting EC-ICS to DCP-ICS, and can then take delivery of the unused water created by Coachella. If the MWD's EC-ICS balance is insufficient to meet the full DCP contribution, the MWD simultaneously creates EC-ICS and converts it to DCP-ICS in the year it is required. If there is 2.7 maf of accumulated ICS, and/or there is insufficient EC-ICS to meet the entire DCP contribution, then the MWD creates non-ICS water (that is, system water) to meet the DCP contribution.

In Arizona, the DCP contributions are assumed to be made through simultaneous creation of EC-ICS and conversion to DCP-ICS in the year it is required, and through non-ICS water. If there is 2.7 maf of accumulated ICS, then Central Arizona Water Conservation District (CAWCD) makes the entire DCP contribution through non-ICS water.

In Mexico, BWSCP contributions are assumed to be made through reductions to Mexico's delivery (that is, via system water), unless Mexico provides other input and assumptions.

D.7.2.6 ICS Assumptions

ICS may be created through various mechanisms, including EC, tributary conservation, system efficiency projects, importation of non-Colorado River water, and transfer of Mexico's Water Reserve to Binational ICS. For modeling purposes in CRMMS, ICS creation and delivery is a combination of inputs and logic.

In CRMMS, ICS is modeled in multiple steps. First, non-junior priority ICS accounts are solved. Second, the preliminary ICS for junior priority accounts is solved. Preliminary ICS represents the ICS creation or delivery volumes that each junior priority entity would like under their ideal scenario. Using the preliminary ICS values, CRMMS then solves the ICS accumulation space sharing. ICS accumulation space sharing, per the agreements signed in 2020 and 2021, allows Lower Division States to take advantage of the full 2.7 maf of ICS storage through a sharing mechanism. Following the ICS accumulation space sharing, the model then adjusts the preliminary ICS accounts

[4] In accordance with the Lower Basin DCP, the maximum total amount of EC-ICS, Binational ICS, and DCP-ICS that may be accumulated by the Lower Division States is 2.7 maf.

appropriately to finalize ICS creation, deliveries, and balances. Finally, water users' diversions are adjusted to reflect ICS creation and deliveries.

D.7.2.6.1 Constants

Table D-11 list the ICS-related assumptions used in CRMMS.

Table D-11
Annual Creation and Delivery Limits

State	Maximum Annual Creation (1,000 af)	Maximum Annual Delivery (1,000 af)
Arizona	100	300
California	400	400
Nevada	125	300

CRMMS models the ICS accumulation space sharing agreements from 2020 and 2021. Therefore, the accumulation limits (**Table D-12**) reflect volumes that differ somewhat from those specified in the 2007 Interim Guidelines and Lower Basin DCP. Additionally, there is logic in CRMMS that allows one or more states to exceed their maximum accumulation limit as long as the total Lower Basin ICS accumulation as defined in the Lower Basin DCP (i.e., sum of EC-ICS, DCP-ICS, and Binational ICS) is less than or equal to 2.7 maf. A state may be required to vacate ICS and/or not create ICS if the ICS accumulation is at 2.7 maf and the state has exceeded its individual accumulation limit. If a state is required to vacate ICS, it will take the following actions until the required volume has been vacated: (1) convert DCP-ICS to system water, (2) take delivery of Tributary ICS and Imported ICS (Nevada only), (3) take delivery of EC-ICS, and (4) take delivery of Binational ICS. Annual ICS assessments for evaporation depend on the entity and year (**Table D-13**).

Table D-12
Accumulation Limits by Entity in CRMMS

Accumulation Limit (af)	Arizona			California			Nevada
	CAWCD	Tribal	Total	IID	MWD	Total	Total
	300,000	300,000	**600,000**	50,000	1,600,000	**1,650,000**	**450,000**

Table D-13
Annual ICS Assessments (percentages)

Entity	Year 1	Year 2	Year 3
Arizona	10	—	—
IID[1]	5	3	3
MWD	10	—	—
Nevada	10	—	—

[1] After the year of creation, a 3 percent evaporation assessment is applied in all non-shortage years.

D.7.2.6.2 Arizona ICS Assumptions

In general, information about the ICS creation is provided to Reclamation by the state, and CRMMS logic is used to model the future ICS delivery and type of ICS created.

Reclamation generally inputs ICS creation volumes for all entities in Arizona based on existing and anticipated ICS creation plans (**Table D-14**). CRMMS allows CAWCD's DCP contribution to be made through creation of ICS and non-ICS water. A default creation volume is input, and rule logic determines whether CAWCD's ICS creation is EC-ICS or DCP-ICS based on the operating condition of the current year.

Table D-14
Assumed ICS Creation and Delivery Volumes in Arizona

		2023	2024	2025	2026
CAWCD	EC-DCP Creation (af)	60,000	60,000	60,000	0
	Binational Creation (af)	9,092	0	0	9,092
	System Efficiency Creation (af)	0	0	0	0
	Default Delivery[1] (af)	80,000	0	0	0
GRIC	EC Creation (af)	0	0	0	0
	Delivery (af)	0	0	0	0

[1] CAWCD delivers an additional 60,000 af when the operating condition is between 1,075 and 1,025 feet for mitigation purposes. Starting in 2026, CAWCD is assumed to also try to take delivery of its remaining ICS by 2036, based on the operating condition.

Reclamation also inputs the assumed ICS delivery volumes for all entities in Arizona, except CAWCD and the GRIC. Assumed delivery volumes for CAWCD incorporate a default assumption provided by CAWCD plus an assumed delivery for mitigation water. Starting in 2026, CAWCD is modeled to try to take delivery of its remaining ICS by 2036, based on the operating condition. Assumed ICS delivery volumes for GRIC are based on the Arizona Firming Agreement and are assumed to start in 2027. There are no ICS deliveries when Lake Mead is projected to decline below elevation 1,025 feet on January 1.

D.7.2.6.3 California ICS Assumptions

CRMMS includes ICS assumptions in California for the IID and MWD (**Table D-15**). Creation volumes of Binational ICS (assumed conversion from Mexico's Water Reserve pursuant to Minute 323) for the IID and MWD, and System Efficiency ICS for the MWD are input into CRMMS.

Table D-15
Assumed ICS Creation Volumes by IID and MWD (af)*

		2023	2024	2025	2026
MWD	**EC-ICS Creation (af)**	**209,000**	—	—	—
	Binational ICS Creation (af)	9,092	0	0	9,092
	System Efficiency ICS Creation (af)	0	0	0	0
IID	Binational ICS Creation (af)	9,092	0	0	9,092

* The 2023 MWD EC-ICS creation is a static volume. For 2024–2026, EC-ICS creation or delivery volumes are dynamic and based on the Sacramento River Water Year Classification (SRWYC; see **Table D-16**).

In general, IID tries to keep its ICS accumulation at its capacity (50,000 af). As such, approximately 1,500 af of EC-ICS can be created in normal, ICS surplus, and domestic surplus years. This volume is enough to keep the EC-ICS accumulation at capacity and cover the annual evaporative assessment (**Table D-13**).

There is no logic to create additional EC-ICS by IID above the 1,500 af lost to evaporation during normal and surplus years. Therefore, if the EC-ICS balance decreases more than 1,500 af due to the assumed behavior in flood control surplus conditions, that ICS balance is not currently replenished in the year(s) following the flood control release.

There is currently no assumed delivery of Binational ICS or EC-ICS by IID.

For the MWD, EC-ICS creation and ICS delivery volumes are based on the annual SRWYC. The SRWYC index is obtained at http://cdec.water.cC.gov/cgi-progs/iodir/WSIHIST and then resampled using the index sequential method, for use with each inflow trace scenario, consistent with the year the Lower Basin hydrology input is from. Other constraints are described below.

EC-ICS will be created per **Table D-16** in Normal and Shortage conditions, subject to ICS accumulation and annual creation limits. ICS creation is also limited to make sure the MWD's annual diversion does not fall below its specified annual minimum diversion of 500,000 af. No creation occurs during surplus or flood control conditions.

Table D-16
EC-ICS Creation and Delivery Volumes by SRWYC

SRWYC	Creation (af)	Delivery (af)
Wet	100,000	0
Above Normal	0	0
Below Normal	0	200,000
Dry	0	400,000
Critical	0	400,000

If a DCP contribution is needed, the MWD converts EC-ICS to meet its contribution. If not enough EC-ICS is available to meet the full DCP contribution, the MWD simultaneously creates

EC-ICS and converts it to DCP-ICS in the year it is required. If insufficient ICS accumulation space exists to create DCP-ICS, then contributions are made via system water.

D.7.2.6.4 Nevada ICS Assumptions

Creation of Tributary Conservation, Imported ICS, and Binational ICS are all inputs in CRMMS (**Table D-17**).

If a DCP contribution is needed, the SNWP converts EC-ICS to meet its contribution. If there is not enough EC-ICS available to meet the full DCP contribution, the SNWP simultaneously creates EC-ICS and converts it to DCP-ICS in the year it is required. If insufficient ICS accumulation space exists to create DCP-ICS, then contributions are made via system water.

EC-ICS is assumed to be created from Nevada's unused apportionment as long as there is ICS accumulation space available. The SNWP's unused apportionment equals the SNWP's apportionment minus shortages and DCP contributions, if EC-ICS was not converted in that year, minus SNWP's annual normal demand.

Table D-17
Assumed ICS Creation Volumes by the SNWP

	2023	2024	2025	2026
Tributary Conservation (af)	30,000	30,000	30,000	30,000
Imported ICS creation (af)	0	0	0	0
Binational ICS creation (af)	9,092	0	0	9,092

ICS can be used to meet the SNWP's water demands; however, it is typically only used when the demands exceed apportionment, or to offset delivery reductions resulting from shortages. In the 5-year modeling period of the June 2023 CRMMS run, the demands do not exceed the SNWP's apportionment.

D.7.2.7 System Conservation

In addition to shortage and DCP contributions based on Lake Mead operations, Lower Basin demands are assumed to be reduced for system conservation after these agreements have been finalized. **Table D-18** shows the system conservation modeled for the No Action Alternative.

Table D-18
No Action Alternative Modeled System Conservation Volumes (af)

Modeled System Conservation	2023	2024	2025	2026	Total
California					
Palo Verde Irrigation District	58,400	39,800	—	—	98,200
California Total	**58,400**	**39,800**	—	—	**98,200**
Arizona					
Gila River Indian Community	91,950	125,000	125,000	—	341,950

Modeled System Conservation	2023	2024	2025	2026	Total
Fort McDowell Yavapai Nation	13,933	13,933	13,933	—	41,799
Central Arizona Project subcontractors	62,200	42,200	42,200	—	146,600
Mohave Valley Irrigation and Drainage District	12,819	—	—	—	12,819
Yuma Mesa Irrigation and Drainage District	13,670	—	—	—	13,670
Gabrych Farms	3,240	3,240	3,240	—	9,720
Arizona Total	**197,812**	**184,373**	**184,373**	**—**	**566,558**
Total Modeled System Conservation	**256,212**	**224,173**	**184,373**	**—**	**664,758**

[1] These model assumptions reflect projected volumes as of June 2023 from executed agreements, and are subject to change. These system conservation volumes are modeling assumptions; they do not represent mandatory shortages, and they do not commit specific water users to these reductions in use.

D.7.3 Proposed Action

The Lake Mead operations and Lower Basin conditions for the Proposed Action are similar to those under the No Action Alternative (that is, shortage and DCP contribution volumes are based on Lake Mead elevations).

D.7.3.1 Surplus

The surplus model assumptions for the Lower Basin under the Proposed Action are identical to those under the No Action Alternative.

D.7.3.2 Normal Conditions

The normal condition model assumptions for the Lower Basin under the Proposed Action are identical to those under the No Action Alternative.

D.7.3.3 Shortage Condition

The shortage condition model assumptions for the Lower Basin under the Proposed Action are identical to those under the No Action Alternative.

D.7.3.4 Minute 323 High- and Low-Elevation Reservoir Conditions

The Minute 323 model assumptions for the Lower Basin under the Proposed Action are identical to those under the No Action Alternative.

D.7.3.5 DCP and BWSCP

The DCP and BWSCP model assumptions for the Lower Basin under the Proposed Action are identical to those under the No Action Alternative.

D.7.3.6 ICS Assumptions

The ICS model assumptions for the Lower Basin under the Proposed Action are identical to those under the No Action Alternative, except for the following updates:

- MWD's 2023 EC-ICS creation volume is set to 216,000 af. The No Action Alterative assumes 209,000 af of ICS creation (see **Table D-17**).
- SNWA's 2023 tributary ICS creation was converted to system water due to the ICS accumulation limit.

- The assumed behavior of a state's ICS activity when the ICS accumulation capacity is full was updated. If a state is required to vacate ICS (as described in **Section D.7.2.6.1** for the No Action Alternative), a state will convert EC-ICS and tributary ICS (Nevada only) to system water instead of taking delivery of the ICS volume.

D.7.3.6 System Conservation

The Proposed Action includes additional system conservation beyond the volumes included under the No Action Alternative. **Table D-19** reports the assumed system conservation modeled for this SEIS.

Table D-19
Proposed Action Modeled SEIS Conservation Volumes (af)

Modeled SEIS Conservation	2023	2024	2025	2026	Total
California					
Coachella Valley Water District	35,000	45,000	45,000	—	125,000
Quechan Indian Tribe	13,000	13,000	13,000	13,000	52,000
Palo Verde Irrigation District	78,000	120,000	120,000	83,000	401,000
Bard Water District	—	6,000	—	—	6,000
Imperial Irrigation District	50,000	250,000	250,000	250,000	800,000
California Total	**176,000**	**434,000**	**428,000**	**346,000**	**1,384,000**
Arizona					
Gila River Indian Community	91,950	145,000	145,000	20,000	401,950
Fort McDowell Yavapai Nation	13,933	13,933	13,933	—	41,799
San Carlos Apache Tribe	23,275	—	—	—	23,275
Colorado River Indian Tribes	37,000	23,000	23,000	—	83,000
Central Arizona Project Subcontractors	143,800	129,800	128,800	—	402,400
Mohave Valley Irrigation and Drainage District	12,819	12,819	12,819	—	38,457
Yuma Mesa Irrigation and Drainage District	13,670	13,670	13,670	—	41,010
Gabrych Farms	3,240	3,240	3,240	—	9,720
Wellton-Mohawk Irrigation and Drainage District	9,000	12,000	12,000	9,000	42,000
Arizona Total	**348,687**	**353,462**	**352,462**	**29,000**	**1,083,611**
Total Modeled SEIS Conservation	**524,687**	**787,462**	**780,462**	**375,000**	**2,467,611**

[1] These model assumptions reflect projected volumes as of June 2023 from executed agreements, agreements that are under development, and planned operations; these assumptions are subject to change. These SEIS conservation volumes are modeling assumptions; they do not represent mandatory shortages, and they in no way commit specific water users to these reductions in use.

D.8 Lake Mohave and Lake Havasu Operations

Lake Mohave and Lake Havasu are operated to meet user-specified target storages at the end of each month. These operations remain consistent for both alternatives. The storage targets and the corresponding elevations for Lake Mohave and Lake Havasu are presented in the following sections.

D.8.1 Lake Mohave/Davis Dam

Lake Mohave is operated to meet monthly elevation targets (**Table D-20**). These elevation targets are based on effective storage space targets set by the US Army Corps of Engineers for Lower Basin flood control purposes, as well as for endangered species operations developed in conjunction with the Fish and Wildlife Service.

Table D-20
Lake Mohave Monthly Elevation and Storage Targets

Month	Lake Mohave Target Elevation (feet)	Lake Mohave Target Storage (1,000 af)
January	641.8	1,666
February	641.8	1,666
March	642.5	1,685
April	643.0	1,699
May	643.0	1,699
June	643.0	1,671
July	642.0	1,658
August	642.0	1,658
September	640.0	1,617
October	630.5	1,371
November	635.0	1,486
December	638.7	1,583

D.8.2 Lake Havasu/Parker Dam

Lake Havasu is operated to meet monthly elevation targets (**Table D-21**). These elevation targets are based on effective storage space targets set by the US Army Corps of Engineers for Lower Basin flood control purposes, as well as for seasonal needs to meet downstream water demands.

Table D-21
Lake Havasu Monthly Elevation and Storage Targets

Month	Lake Havasu Target Elevation (feet)	Lake Havasu Target Storage (1,000 af)
January	446.5	552
February	446.5	552
March	446.7	555
April	448.7	593
May	448.7	593
June	448.7	593
July	448.0	580
August	447.5	571
September	447.5	571
October	447.5	571
November	447.5	571
December	446.5	552

D.9 Energy Generation

RiverWare™ includes a variety of methods that can be chosen to compute electrical power generation and estimate generation capacity. All methods compute power and energy on a monthly basis. These results can be used to estimate revenue and total economic value. The following sections describe the methods used to compute power at Glen Canyon Dam, Hoover Dam, Davis Dam, and Parker Dam.

D.9.1 Glen Canyon Dam

While CRMMS includes a RiverWare™ method to compute electrical power generated from Glen Canyon Dam, the power generation data used in **Section 3.15** are computed using Generation Transmission Maximization Model (GTMax) Lite.

If the previous month's elevation is less than 3,490 feet, there is no power or energy generated for the current month. This elevation reflects the minimum power pool elevation at Lake Powell.

D.9.2 Hoover Dam

The method that computes power and energy generated at Hoover Dam, which is the same method used in CRSS for the 2007 FEIS, assumes two levels of power generation. The lower level of generation occurs at base flow, while the upper level occurs at peak flow. The method computes the fraction of the month that the powerplant is operated at peak flow and base flow. The peak flow is the most efficient flow through the turbines for the current operating head, while the base flow represents the minimum flow through the turbines to produce energy.

The base flow and corresponding power generation are based on the outflow for the current month. The peak flow must be computed through an iterative procedure using operating head, tailwater elevation, and turbine release. The initial turbine release is assumed to be that corresponding to maximum power production. Tailwater elevation at Hoover Dam is computed as a function of Lake Mohave elevation and Hoover Dam release.

The monthly Hoover Dam release volume at the base flow is computed by applying the base flow over the month. The monthly release volume at the peak flow is computed as:

$$PeakFlowVolume = TurbineReleaseVolume - BaseFlowVolume$$

Next, the number of hours required for operation at base and peak flows are computed as:

$$PeakHours = \frac{PeakFlowVolume}{(PeakFlow - BaseFlow) * 3600}$$

$$BaseHours = \frac{SecondsInMonth}{3600} - PeakHours$$

where 3,600 is the amount of seconds per hour.

If the peak hours are greater than the length of the month, the peak hours' value is set equal to the length of the month, and the base hours value is set to zero. The peak and base hours are then

multiplied by the powerplant capacity at each level and added together to obtain the total energy produced for the month. Power is computed as the energy divided by the length of the month in hours.

The algorithm described above allows power generation at elevations below approximately 950 feet, which is the minimum power pool at Lake Mead. According to the algorithm, power is generated as long as the minimum operating head of 304 feet is available, corresponding to an elevation of about 950 feet. Because there is no operating experience at these elevations, it is impossible to verify whether CRMMS mimics the actual turbine performance at such low heads. It is, therefore, critical to view energy results from CRMMS in a relative manner and not in a strict numeric sense.

Power capacity is the power that could be generated if the flow is directed through the penstock turbine(s) with a given operating head. This is computed to distinguish between actual power production and the power that could be produced.

D.9.3 Davis Dam

The method that computes power and energy generation at Davis Dam uses an empirical relationship as a function of flow, operating head, plant efficiency, and user-specified power coefficients. This empirical relationship is estimated by Reclamation and was last updated in 2019 using January 2012–September 2018 historical data. Energy is computed using this empirical relationship as:

$$Energy\ (MWH) = \left(C_1 * \frac{62.4}{737.5} * Outflow\ (1000\ cfs) * HoursInMonth * \frac{OperatingHead\ (ft)}{1000} - C_2 \right) * eff * 1000$$

where 62.4 is the unit weight of water in pounds per cubic foot; 737.5 represents foot-pounds per second per kilowatt; C_1 is estimated to be 0.88 based on historical data; C_2 is estimated to be 0; and eff is set to 1.0. C_1 and eff are representations of the efficiency of the powerplant, where C_1 must be a static value through the entire simulation; eff can vary (by month and/or year). C_2 represents any energy consumed within the powerplant and is set to 0 because Reclamation does not have necessary data to determine C_2.

This energy method is different from the method used in CRSS for the 2007 FEIS; this is because the analysis of energy methods in RiverWare indicated the new method simulates historical energy generation better than the method previously used in CRSS. This new method does not currently estimate the power capacity at Davis Dam, which was computed by the method used for the 2007 FEIS.

D.9.4 Parker Dam

The method that computes power and energy generation at Parker Dam is the same method used for Davis Dam, except C_1 is set to 1.0; C_2 is estimated to be 0; and eff varies by month, as shown

in **Table D-22**. The monthly efficiency coefficients are based on an analysis of historical data from Power, Operations, and Maintenance reports (January 2000–April 2021).

Table D-22
Parker Dam Monthly Efficiency Coefficients

Month	Coefficient
January	0.8192
February	0.8583
March	0.8645
April	0.8732
May	0.8705
June	0.8703
July	0.8658
August	0.8631
September	0.8588
October	0.8636
November	0.8369
December	0.7710

In June 2022, this energy method was implemented in CRMMS for Parker Dam after performing analyses of different methods in RiverWare and comparing the simulated energy to actual energy as reported in historical reports. The new method was shown to outperform the previous method (used in the 2007 FEIS), particularly at higher flow and generation levels.

D.10 References

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Attachment D-1

CRMMS Lake Powell Assumed Monthly Releases

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Attachment D-1. CRMMS Lake Powell Assumed Monthly Releases

Table Attachment D-1
CRMMS Lake Powell Assumed Monthly Releases
(Values in af)

Annual Total	October	November	December	January	February	March	April	May	June	July	August	September
0	0	0	0	0	0	0	0	0	0	0	0	0
7,000,000	480,000	500,000	600,000	664,000	587,000	620,000	552,000	550,000	577,000	652,000	696,000	522,000
7,480,000	480,000	500,000	600,000	723,000	639,000	675,000	601,000	599,000	628,000	709,000	758,000	568,000
8,230,000	643,000	642,000	715,000	763,000	675,000	713,000	635,000	632,000	663,000	749,000	800,000	600,000
9,000,000	643,000	642,000	715,000	857,000	758,000	801,000	713,000	710,000	745,000	842,000	900,000	674,000
9,500,000	643,000	642,000	715,000	919,000	813,000	858,000	764,000	761,000	798,000	902,000	963,000	722,000
10,000,000	643,000	642,000	715,000	980,000	870,000	920,000	810,000	810,000	850,000	960,000	1,030,000	770,000
10,500,000	643,000	642,000	715,000	1,041,000	921,000	973,000	866,000	862,000	905,000	1,022,000	1,091,000	819,000
11,000,000	643,000	642,000	715,000	1,102,000	975,000	1,030,000	917,000	913,000	958,000	1,082,000	1,156,000	867,000
11,500,000	643,000	642,000	715,000	1,160,000	1,030,000	1,090,000	970,000	960,000	1,010,000	1,140,000	1,220,000	920,000
12,000,000	643,000	642,000	715,000	1,225,000	1,083,000	1,145,000	1,020,000	1,014,000	1,064,000	1,202,000	1,284,000	963,000
12,500,000	643,000	642,000	715,000	1,290,000	1,140,000	1,200,000	1,070,000	1,060,000	1,120,000	1,260,000	1,350,000	1,010,000
13,000,000	643,000	642,000	715,000	1,347,000	1,192,000	1,259,000	1,121,000	1,116,000	1,171,000	1,322,000	1,413,000	1,059,000
13,500,000	643,000	642,000	715,000	1,410,000	1,250,000	1,320,000	1,170,000	1,170,000	1,220,000	1,380,000	1,480,000	1,100,000
14,000,000	643,000	642,000	715,000	1,470,000	1,300,000	1,373,000	1,223,000	1,217,000	1,277,000	1,443,000	1,537,000	1,160,000
14,500,000	643,000	642,000	715,000	1,530,000	1,350,000	1,430,000	1,270,000	1,270,000	1,330,000	1,500,000	1,600,000	1,220,000
15,000,000	643,000	642,000	715,000	1,590,000	1,410,000	1,490,000	1,320,000	1,320,000	1,380,000	1,560,000	1,670,000	1,260,000
15,500,000	650,000	650,000	750,000	1,650,000	1,450,000	1,540,000	1,370,000	1,370,000	1,420,000	1,620,000	1,730,000	1,300,000
16,000,000	650,000	650,000	800,000	1,720,000	1,490,000	1,590,000	1,410,000	1,420,000	1,480,000	1,670,000	1,780,000	1,340,000
16,500,000	650,000	650,000	800,000	1,770,000	1,550,000	1,650,000	1,470,000	1,460,000	1,530,000	1,730,000	1,850,000	1,390,000
17,000,000	650,000	650,000	800,000	1,840,000	1,600,000	1,700,000	1,510,000	1,510,000	1,590,000	1,790,000	1,920,000	1,440,000
17,500,000	650,000	650,000	800,000	1,900,000	1,650,000	1,760,000	1,560,000	1,570,000	1,640,000	1,850,000	1,980,000	1,490,000
18,000,000	650,000	650,000	800,000	1,960,000	1,710,000	1,820,000	1,620,000	1,620,000	1,690,000	1,910,000	2,040,000	1,530,000
20,000,000	800,000	800,000	1,000,000	2,000,000	1,760,000	1,880,000	1,980,000	2,040,000	1,980,000	2,040,000	2,040,000	1,680,000
30,000,000	1,600,000	1,600,000	1,900,000	2,500,000	1,900,000	2,500,000	2,500,000	2,800,000	3,100,000	3,400,000	3,400,000	2,800,000
50,000,000	2,666,667	2,666,667	3,166,667	4,166,667	3,166,667	4,166,667	4,166,667	4,666,667	5,166,667	5,666,667	5,666,667	4,666,667
75,000,000	4,000,000	4,000,000	4,750,000	6,250,000	4,750,000	6,250,000	6,250,000	7,000,000	7,750,000	8,500,000	8,500,000	7,000,000

Footnote:
Releases from 7.0 to 14.0 maf are from LTEMP; releases outside this range are interpolated from LTEMP patterns for modeling purposes.

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Attachment D-2

Issue in Modeled Lake Powell Releases in the No Action Alternative

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Attachment D-2. Issue in Modeled Lake Powell Releases in the No Action Alternative

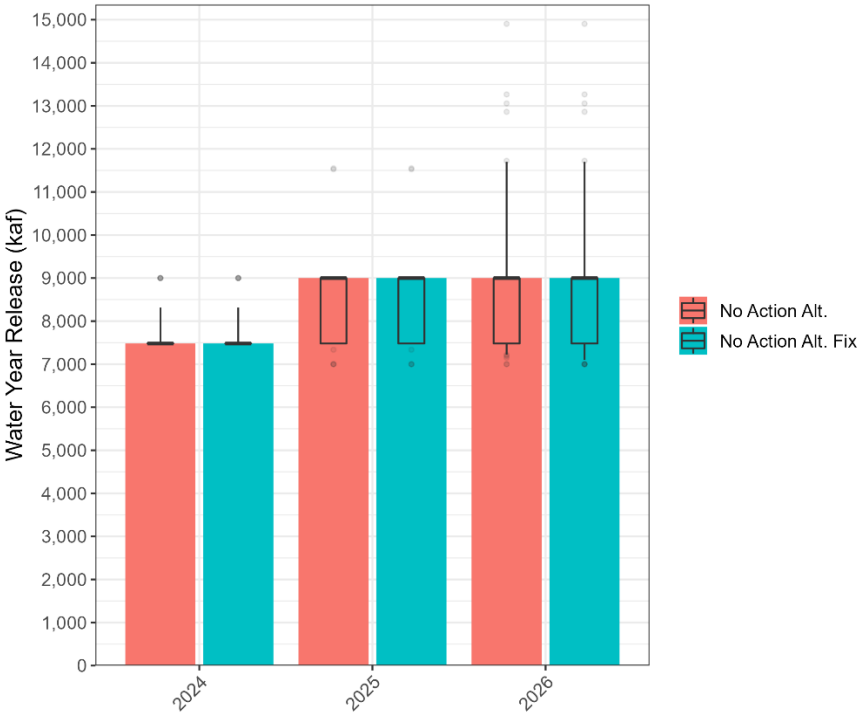
Reclamation found a minor issue with modeled Lake Powell releases under certain conditions in the No Action Alternative. The issue was due an error in calculating balancing releases when Lake Powell could not release the full target water year release volume due to bypass tube capacity constraints when Lake Powell was below minimum power pool. The issue does not affect results for any other alternatives. This Attachment compares the published "No Action Alt." used throughout this SEIS to the "No Action Alt. Fix", which fixes the issue. Because the differences in the results are so minor, the modeling, analysis, and resource impacts throughout this SEIS continue to use the "No Action Alt.".

The issue resulted in changes to water year 2026 Lake Powell releases in 4 out of 90 traces. In these cases, Lake Powell released slightly more water in the No Action Alt. than in the No Action Alt. Fix. **Table Attachment D-2** compares the water year 2026 release for these four traces. The issue did not affect results overall, with no changes to the percent of traces dropping below critical elevations. A minor difference can be seen in the lower whiskers of the 2026 boxplot of Lake Powell water year releases (**Figure Attachment D-1**).

Table Attachment D-2
Comparison of Lake Powell water year 2026 release between the No Action Alt. and No Action Alt. Fix for the four traces that changed due to the fix.

No Action Alt. (maf)	No Action Alt. Fix (maf)	Difference (maf)
7.15	7.00	0.15
7.19	7.00	0.19
7.59	7.00	0.59
7.29	7.22	0.07

Figure Attachment D-1
Lake Powell Water Year Release



The projected Lake Powell and Lake Mead monthly pool elevations have minor differences in 2026. The small differences are not visible at Lake Powell in the scale shown in **Figure Attachment D-2**. There are slightly lower pool elevations with the fix projected at Lake Mead that do show up in **Figure Attachment D-3**, but no differences in Lake Mead release or deliveries in the Lower Basin.

Figure Attachment D-2
Lake Powell End-of-Month Pool Elevation

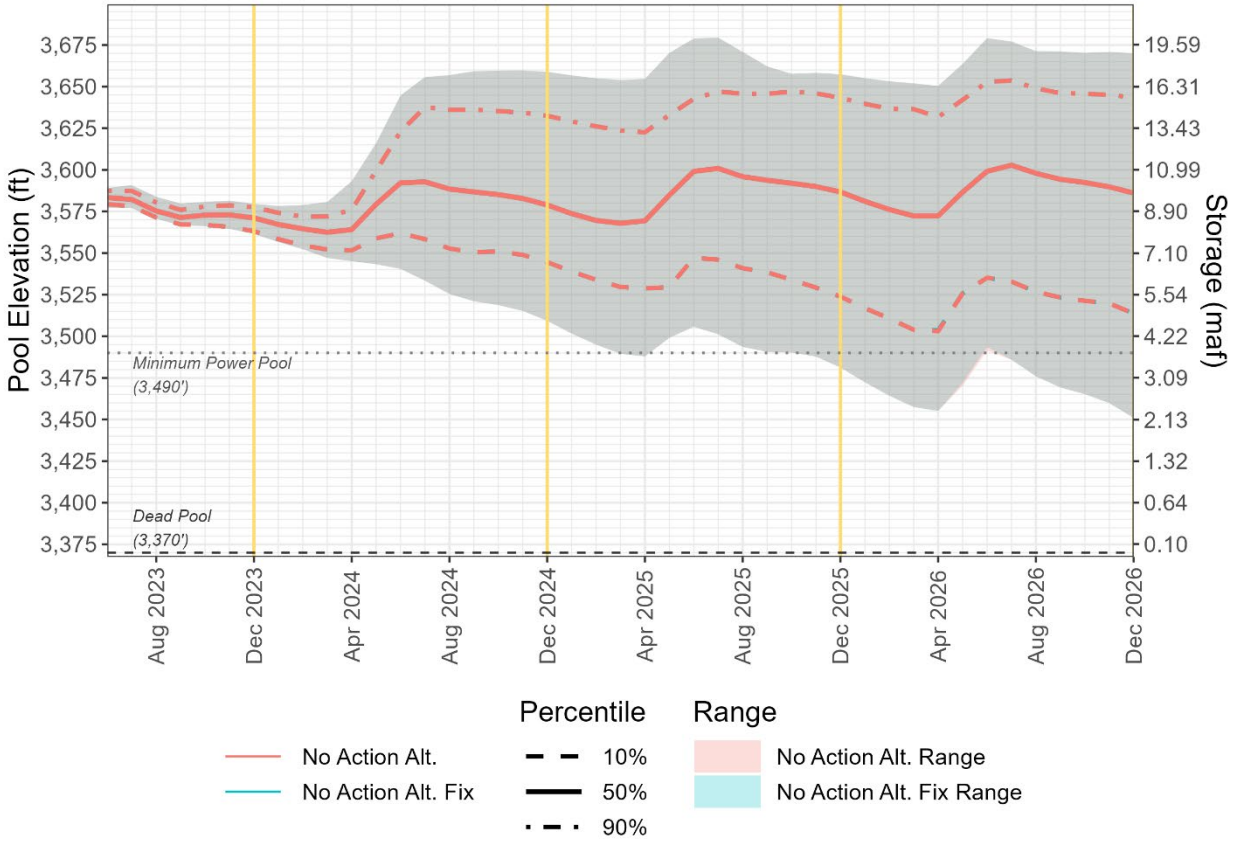
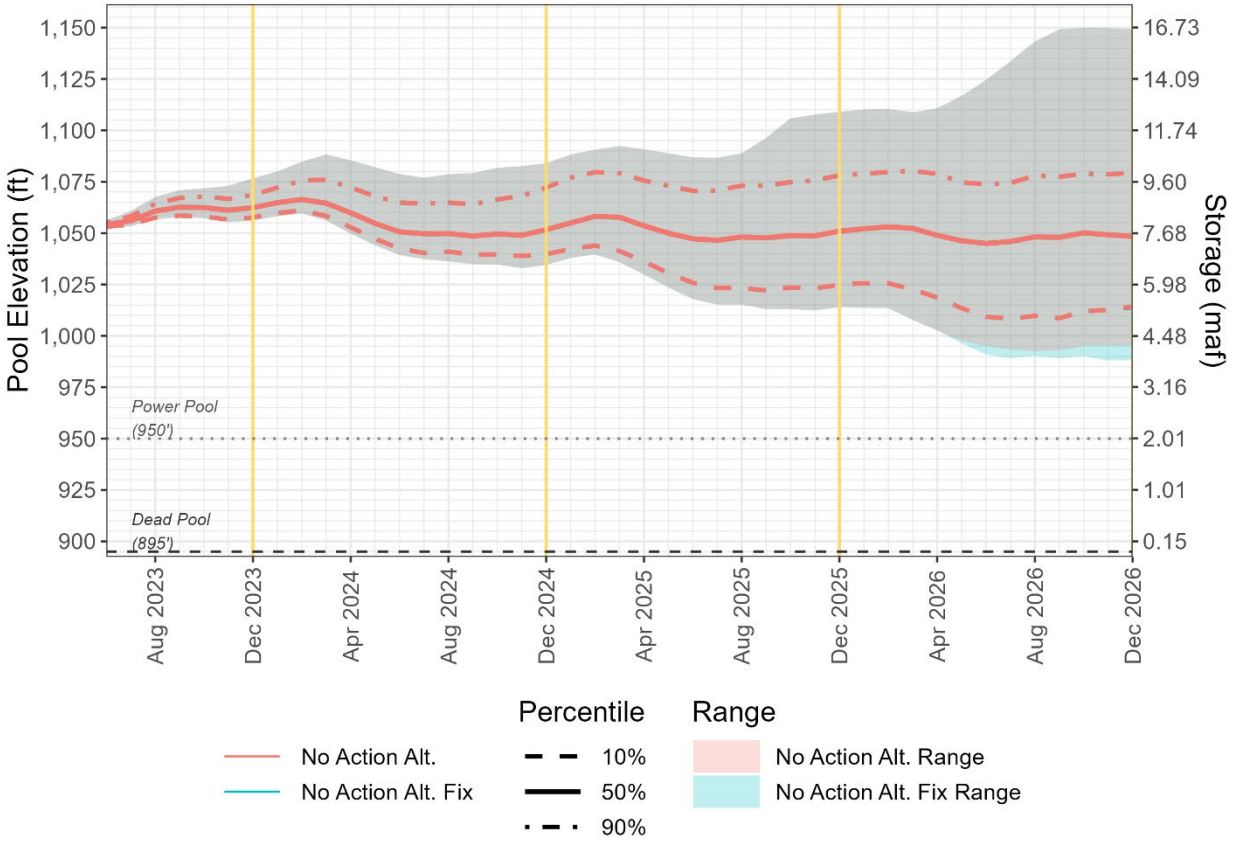


Figure Attachment D-3
Lake Mead End-of-Month Pool Elevation



Attachment D-3

CRMMS Lower Basin Water User Depletion Schedules

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Attachment D-3. CRMMS Lower Basin Water User Depletion Schedules

Table Attachment D-3
CRMMS Input Annual Lower Basin Water User Depletion Schedules (Values in af)

State	CRMMS Water User	2023	2024	2025	2026
Arizona	AzPumpersAbvImp	5,742	5,678	5,678	5,678
	AzPumpersBlwImp	8,984	8,984	8,984	8,984
	AzPumpersDvsToPkr	949	949	949	949
	BrookeWater	318	327	327	327
	BullheadCity	8,246	8,799	8,799	8,799
	CAP	851,619	1,524,366	1,524,366	1,524,366
	CibolaNWR	14,329	14,264	14,264	14,264
	CibolaValleyIID	12,761	13,090	13,090	13,090
	City of Parker	386	418	418	418
	City of Yuma	14,747	15,151	15,151	15,151
	Cocopah Indian Res	1,770	1,822	1,822	1,822
	CRIRAz	352,860	360,641	360,641	360,641
	DavisDamProject	2	2	2	2
	DesertLawnMemorial	27	27	27	27
	Ehrenberg	263	260	260	260
	Ft Yuma	3,123	3,123	3,123	3,123
	FtMohaveAz	39,285	44,280	44,280	44,280
	Gila Monster Farms	4,221	4,833	4,833	4,833
	GoldenShores	287	287	287	287
	HavasuNWR	2,924	3,564	3,564	3,564
	ImperialNWR	3,567	3,799	3,799	3,799
	LakeHavasuCity	8,850	9,052	9,052	9,052
	LMNRA Az Mead	69	68	68	68
	LMNRA Az Mohave	219	218	218	218
	MCAirStation	1,173	1,265	1,265	1,265
	MohaveValleyIID	17,279	22,815	22,815	22,815
	MohaveWaterConsDist	765	749	749	749
	NGVIDD	8,474	9,486	9,486	9,486
	SouthernPacific	29	29	29	29
	UnitB	13,980	12,220	12,220	12,220
	UofA	832	897	897	897
	WMIDD	253,149	278,000	278,000	278,000
	YAO	206	206	206	206
	YCWUA	260,208	277,259	277,259	277,259
	YID	35,774	38,958	38,958	38,958
	YMIDD	97,109	108,402	108,402	108,402
	YumaProvingGround	457	486	486	486
	YumaUnionHighScl	138	150	150	150

State	CRMMS Water User	2023	2024	2025	2026
Nevada	BasicManagement	0	0	0	0
	BigBend	4,080	4,704	4,704	4,704
	BoulderCanyonProject	300	300	300	300
	City of Henderson	0	0	0	0
	FtMohaveNv	3,666	4,623	4,623	4,623
	LMNRA Mead	1,241	1,500	1,500	1,500
	LMNRA Mohave	394	500	500	500
	LVWashReturns	234,967	222,204	222,204	222,204
	NvDeptFishGame	0	0	0	0
	PacificCoastBuilding	889	928	928	928
	SCE	0	0	0	0
	SNWADiversion	436,780	509,772	509,772	509,772
California	CaPumpersAbvImp	53	53	53	53
	CaPumpersDvsToPkr	414	414	414	414
	Chemehuevi	183	183	183	183
	Coachella	370,647	394,000	399,000	404,000
	CRIRCa	4,380	4,380	4,380	4,380
	FtMohaveCa	8,197	8,994	8,994	8,994
	FYIR_Ranches	2,331	2,332	2,332	2,332
	IID	2,580,442	2,612,800	2,607,800	2,607,800
	MWD	802,932	875,507	875,507	797,400
	MWDDiversion	805,543	878,107	878,107	800,000
	MWDReturns	2,611	2,600	2,600	2,600
	Needles	1,403	1,605	1,605	1,605
	PaloVerde	388,784	362,104	362,104	362,104
	SaltonSea	0	0	0	0
	Winterhaven	58	58	58	58
	YumaIsland	1,463	1,463	1,463	1,463
	YumaProject	44,844	48,668	48,668	48,668
Mexico	MexicoSched	1,404,713	1,500,000	1,500,000	1,500,000
	MexicoBypass	123,169	117,192	117,192	117,192
	MexicoExcess	35,781	28,963	28,963	28,963
	MexicoTJ	2,348	0	0	0

Footnotes:
Water user names in the table reflect the water user names in the June 2023 CRMMS. Water user names may have been updated in the Lower Basin Water Accounting Reports, and/or they may not match the Lower Basin Water Accounting Reports.

Appendix E

Shortage Allocation Model Documentation

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Attachments

E-1 Reclamation's September 14, 2022, letter notifying interested parties of a Tier 2 Shortage Condition and required DCP contributions in operational year 2023

E-2 Reclamation's September 28, 2022, letter to the Central Arizona Water Conservation District announcing the operational year 2023 Available CAP Supply

E-3 Exhibit 5.3.4.1 to the Tohono O'odham Settlement Agreement, *Secretary's Approach for Determining the Amount of Water Available to the Nation During a Time of Shortage Under 1980 Contract*

Acronyms and Abbreviations

	Full Phrase
2007 FEIS	2007 Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead Final Environmental Impact Statement
2007 ROD	Record of Decision for the adoption of Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead
ADWR	Arizona Department of Water Resources
af/AF	acre-foot/feet
AFY	acre-feet per year
AOP	Annual Operating Plan
AWSA	2004 Arizona Water Settlements Act
CAP	Central Arizona Project
CAWCD	Central Arizona Water Conservation District
CRBPA	Colorado River Basin Project Act of 1968
CRMMS	Colorado River Mid-term Modeling System
CU	Consumptive Use
CVWD	Coachella Valley Water District
DCP	2019 Lower Basin Drought Contingency Plan
ICS	Intentionally Created Surplus
Interim Guidelines	2007 Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead
KAF	thousand acre-feet
LCWSP	Lower Colorado Water Supply Project
LMNRA	Lake Mead National Recreation Area
Lower Division States	Arizona, California, and Nevada
M&I	Municipal and Industrial (priority)
maf	million acre-feet
MWD	The Metropolitan Water District of Southern California
NIA	Non-Indian Agricultural (priority)
PABCO	Pacific Coast Building Products, Inc.
PPR	Present Perfected Right
QSA	Quantification Settlement Agreement
Reclamation	Bureau of Reclamation

Secretary	Secretary of the Interior
SEIS	Supplemental Environmental Impact Statement
SNWA	Southern Nevada Water Authority

Appendix E. Shortage Allocation Model Documentation

This appendix describes the Shortage Allocation Model and assumptions that were used to allocate shortages to water users in the States of Arizona, California, and Nevada (Lower Division States) as part of the analysis of alternatives in this SEIS. Similar material was contained within Appendix G, Shortage Allocation Model Documentation, to the 2007 Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead – Final Environmental Impact Statement (2007 FEIS).

E.1 Introduction

To help assess the general effects of changes in the quantity of Colorado River water supplies available to water users in the Lower Division States[1] under the alternatives analyzed in this SEIS, the Bureau of Reclamation developed a Shortage Allocation Model and documented the specific modeling assumptions in this appendix. This work is a supplement to a 2007 Shortage Allocation Model developed as part of the 2007 FEIS, reflecting the current conditions of Colorado River water use in the Lower Division States and the operating guidelines under review in this SEIS.

E.2 Background and Purpose

The Shortage Allocation Model was created to estimate the quantity of Colorado River water that would be available to water entitlement holders or water users under shortage conditions on the mainstream lower Colorado River over a specified range of shortage volumes. A shortage condition would exist during a year when the Secretary of the Department of the Interior (Secretary), as documented in the Annual Operating Plan (AOP), determines that there is less than 7.5 million acre-feet (maf) of water available to the Lower Division States.

The Shortage Allocation Model, which is described in detail in the following sections, requires certain modeling assumptions with regard to how shortages may be allocated. Reclamation acknowledges there may be other interpretations of how shortages could be distributed. These modeling assumptions are not intended to represent current or future policy with respect to shortage sharing or to limit Secretarial discretion to distribute shortages. The Shortage Allocation Model is not a substitute for the annual process of reviewing water orders and determining annual water

[1] The US will conduct all necessary and appropriate discussions regarding the proposed federal action and implementation of the 1944 Water Treaty with Mexico through the International Boundary and Water Commission in consultation with the Department of State.

availability for each water entitlement holder on the lower Colorado River and, as such, cannot replicate the precision required for that process.

The Shortage Allocation Model simulates shortage allocations and adjusts deliveries of Colorado River water in accordance with the priority of entitlements within each of the Lower Division States' apportionments. Entitlement holders are all persons or entities authorized to beneficially use Colorado River water pursuant to: 1) a right decreed by the United States Supreme Court, 2) a contract for the delivery of Colorado River water through the Secretary, or 3) a Secretarial reservation. For a current list of each state's Colorado River water entitlement holders, please see: https://www.usbr.gov/lc/region/g4000/contracts/entitlements.html. The Shortage Allocation Model for this SEIS only reflects the application of the priority system over a limited range of shortage volumes representing current commitments pursuant to the 2007 Interim Guidelines and 2019 Lower Basin Drought Contingency Plan (DCP).

For the purposes of this SEIS, shortages implemented through operational decisions are referred to as "shortages", whereas shortages incurred as a result of unplanned or unforeseen hydrologic events and when water delivery requirements cannot be met are referred to as "system shortages". The Shortage Allocation Model cannot represent the effect of potential system shortages or physical limitations on access to water due to low river stage.

The Shortage Allocation Model developed for this SEIS is not intended as an implementation tool, and it should only be used for decision support as part of this SEIS.

E.3 Shortage Allocation Model Assumptions

The alternatives describe the continued implementation of existing agreements that control operations of Glen Canyon and Hoover Dams. These include the 2007 Interim Guidelines for the remainder of the interim period (through the 2026 operating year) and the 2019 DCPs. The Shortage Allocation Model is a set of Microsoft Excel worksheets that simulate shortages and distribute available water first among the Lower Division States based on the 2007 ROD and 2019 DCP and then among the entitlement holders within each state based on priority or as otherwise provided by the 2019 DCP.

The discrete volumes of total shortage to the Lower Division States considered in the Shortage Allocation Model comprise the 2007 Interim Guidelines shortage reductions and 2019 DCP water savings contributions, based on Lake Mead elevations. These volumes (in AF) are:

- 200,000
- 533,000
- 617,000
- 867,000
- 917,000
- 967,000

- 1,017,000
- 1,100,000

E.3.1 Distribution Among States

The Shortage Allocation Model distributes shortages among states based on state reductions specified in the 2007 Interim Guidelines. The Shortage Allocation Model also simulates water savings contributions that were distributed among states as agreed to in the 2019 DCP. For the purpose of analyzing the impacts of alternatives considered in this SEIS, DCP contributions are assumed to represent reductions in deliveries, although parties retain flexibility in how to meet those contribution commitments.

Table E-1 below shows a distribution of shortage among the Lower Division States (which consists of both 2007 Interim Guidelines shortages and 2019 DCP water savings contributions) and corresponding volumes of water available to each Lower Division State.

Table E-1
Summary of Shortage Volumes by Lower Division State Under the Shortage Allocation Model

Total Lower Division States Shortage Volumes (AF)	Arizona Shortage Volume (AF)	Arizona Available Water (AF)	California Shortage Volume (AF)	California Available Water (AF)	Nevada Shortage Volume (AF)	Nevada Available Water (AF)
(200,000)	(192,000)	2,608,000	-	4,400,000	(8,000)	292,000
(533,000)	(512,000)	2,288,000	-	4,400,000	(21,000)	279,000
(617,000)	(592,000)	2,208,000	-	4,400,000	(25,000)	275,000
(867,000)	(640,000)	2,160,000	(200,000)	4,200,000	(27,000)	273,000
(917,000)	(640,000)	2,160,000	(250,000)	4,150,000	(27,000)	273,000
(967,000)	(640,000)	2,160,000	(300,000)	4,100,000	(27,000)	273,000
(1,017,000)	(640,000)	2,160,000	(350,000)	4,050,000	(27,000)	273,000
(1,100,000)	(720,000)	2,080,000	(350,000)	4,050,000	(30,000)	270,000

E.3.2 Distribution Within States

E.3.2.1 Introduction

In accordance with Section II(B)(3) of the Consolidated Decree and Section 301(b) of the CRBPA, the Secretary has the authority to declare and allocate shortages to the Lower Division States. Some explicit guidance is given by the Supreme Court and Congress with regard to how shortages would be allocated according to priority, and additional detail is based on interpretation of intra-state priority systems and water delivery contracts executed on behalf of the Secretary in accordance with Section 5 of the Boulder Canyon Project Act.

To estimate the impacts of given levels of shortage, assumptions were made with regard to how shortages might be shared. These assumptions are made to facilitate analysis of the potential impacts

and they are not intended to represent current or future policy with respect to shortage allocation. The Shortage Allocation Model is not designed to replicate some of the annual processes that must be undertaken in determining the quantity of water that can be approved for diversion by specific users.

E.3.2.2 General State Assumptions

- Each state is using its entire apportionment each year.
- For the purpose of analyzing the impacts of alternatives considered in this SEIS, DCP contributions are assumed to represent reductions in deliveries, although parties retain flexibility in how to meet those contribution commitments.
- Because state apportionments are quantified in terms of consumptive use, unquantified and diversionary entitlements were estimated in terms of an equivalent consumptive use. For diversionary entitlements, the consumptive use to diversion ratios for calculating consumptive use equivalent entitlements were derived from the 2021 *Colorado River Accounting and Water Use Report: Arizona, California, and Nevada*[2] or equivalent source data for each entitlement holder (with the exception of Present Perfected Rights (PPRs) for which the Supreme Court estimated both a diversion and consumptive use). Unquantified entitlements were modeled at their level of consumptive use in 2021, including conservation activities; this should not be taken as a limit on the future exercise of those entitlements.
    - As of the date the Shortage Allocation Model was prepared for this SEIS, Reclamation's determination of a 2024 Shortage Condition was forthcoming, including documentation of the 2022 published water accounting data that will affect contractual determinations of Colorado River water availability in 2024. This Appendix E therefore uses 2021 water accounting data to remain consistent with Attachments E-1 and E-2, the most current available official documentation of some of the shortage calculations referenced in this document.
- Entitlement holders with multiple priorities are assumed to divert their highest-priority water first, until it is fully utilized, although specific geographic restrictions may exist for the actual use of various priorities.
- Entitlements are used as the basis for distributing the available water supply to individual users.
- With the exception of PPRs, entitlement holders within a priority or sub-priority share in a pro-rata distribution of available water on the basis of entitlement, unless another distribution is prescribed by contract or other determination. Within priorities other than PPRs, priority dates are not considered except as they pertain to grouping entitlements by priority.
- Current and/or future paybacks of overruns or underruns under the Inadvertent Overrun and Payback Policy, creation or use of Intentionally Created Surplus (ICS), or interstate storage and release are not considered in the Shortage Allocation Model.

[2] Internet website: https://www.usbr.gov/lc/region/g4000/4200Rpts/DecreeRpt/2021/2021.pdf, also known as "Decree Accounting".

- PPRs (on a consumptive use or equivalent basis) are not included in the distribution of shortage within each state; they are subtracted from the water calculated to be available to each state, which water is then distributed in satisfaction of non-PPR entitlements, and the PPRs are accounted for in a separate PPR worksheet. A fill order is assumed for PPRs (see **Section E.3.3**), although no shortages are modeled to invoke that fill order.
- Individual entitlements are assigned to one of three categories (domestic, irrigation, or Tribal) by their primary use or intended benefit, for the purpose of generalizing shortage impacts. No attempt is made to pro-rate shared irrigation and domestic entitlements by actual use. The current proportions of irrigation and domestic use of these entitlements may change in a shortage condition due to contract-specific terms and conditions and/or the discretion of the entitlement holder.

E.3.2.3 Nevada Assumptions

- Nevada has eight water delivery priorities as established in the Robert B. Griffith Water Project Contract No. 7-07-30-W0004, as amended, for delivery of Colorado River water between the US and the State of Nevada; the contract also provides for the Southern Nevada Water Authority (SNWA) to divert the balance of any remaining un-allocated, unused, and surplus water in Nevada. **Table E-2** summarizes that priority system, which is also available at https://www.usbr.gov/lc/region/g4000/contracts/entitlements.html.
- Deliveries to Nevada are no longer assumed to be constrained by Lake Mead surface elevation as assumed in the 2007 FEIS; however, the Shortage Allocation Model does not reflect the effect of potential system shortages or physical limitations on access to water.
- The Shortage Allocation Model calculates shortage to Nevada entitlement holders relative to their consumptive use entitlement (or equivalent); however, the discrete volumes of total shortage considered in the Shortage Allocation Model pursuant to the 2007 Interim Guidelines and 2019 DCP do not result in priority system-based reductions to Nevada parties other than SNWA. The SNWA member agencies may make further arrangements for the distribution of water amongst themselves during a Shortage Condition.

Table E-2
Framework for Priority-Based Distribution of Available Water Within Nevada

Priority	Entitlement Holder	Contract No.	Priority Date	Use	Entitlements		
					Diversion (AFY)	CU or Estimated Equivalent (AFY)[1]	Cumulative CU (AFY)
9th	Any contracts dated after 3-2-1992, SNWA Contract	-	-	-	-	-	-
8th – Balance & Surplus	Southern Nevada Water Authority	2-07-30-W0266	3/2/1992	M&I	balance + surplus	93,975	-
8th – Balance & Surplus	**TOTAL**	-	-	-	-	93,975	291,303
8th	Big Bend Water District	2-07-30-W0269	3/2/1992	M&I	10,000	4,718	-
8th	Robert B. Griffith Project Sub. to City of Boulder City (8,918af) Sub. to City Henderson (27,021af) Sub. to City of North Las Vegas (26,635af) Sub. to Las Vegas Valley Water District (232,426af)	7-07-30-W0004	3/2/1992	M&I	308,000	146,342	-
8th	**TOTAL**	-	-	-	**318,000**	151,060	197,327
7th	Southern Nevada Water Authority (Formerly Boy Scouts of America)[2]	9-07-30-W0011	11/8/1978	M&I	10	5	-
7th	Bureau of Reclamation (includes Sportsman Park)	Secretarial Res.	11/9/1998	M&I	300	168	-
7th	Nevada Dept. of Wildlife (formerly Nevada Dept. of Fish & Game)	14-06-300-2405	10/18/1972	M&I	-	25	-
7th	US Air Force (4,000af) (Delivery from SNWA)[2]	F26600-78-DOO11, amended by F-26600-01-D-A111 (Included in 07-07-30-W0004 in P8)	1/23/1978, amended 5/1/2000	-	4,000	1,901	-
7th	**TOTAL**	-	-	-	**4,310**	2,099	46,267
6th	Las Vegas Valley Water District[2]	14-06-300-2130	9/22/1969	M&I	15,407	7,320	-
6th	**TOTAL**	-	-	-	**15,407**	7,320	44,169
5th	Lakeview Company (Hacienda Casino)	14-06-300-1523	2/12/1965	M&I	0	0	-
5th	Pacific Coast Building Products, Inc. (PABCO)	5-07-30-W0089	6/19/1985	M&I	928	928	-
5th	**TOTAL**	-	-	-	**928**	928	36,848

Priority	Entitlement Holder	Contract No.	Priority Date	Use	Entitlements		
					Diversion (AFY)	CU or Estimated Equivalent (AFY)[1]	Cumulative CU (AFY)
4th	Basic Water Company (formerly Basic Management, Inc.)	14-06-300-2083	9/18/1969	M&I	8,208	8,208	-
4th	City of Henderson	0-07-30-W0246	9/18/1969	M&I	15,878	14,503	-
4th	Southern Nevada Water Authority (From Basic Water Company)[2]	2-07-30-W0266	9/18/1969	M&I	14,950	7,103	-
4th	**TOTAL**	-	-	-	**39,036**	29,814	35,920
3rd	Boulder City[3]	14-06-300-978	5/15/1931	M&I	5,876	5,876	-
3rd	**TOTAL**	-	-	-	5,876	5,876	6,106
2nd	Lake Mead National Recreation Area[4], Executive Order No. 5339	1964 Decree	4/25/1930	M&I	Unquantified, estimated ~1,500	230	-
2nd	**TOTAL**	-	-	-	**1,500**	230	230
-	**NEVADA TOTALS**	-	-	-	385,057	291,303	-

Note: CU means Consumptive Use. All units are in acre-feet per year. The Cumulative CU column is included as a reference for the estimated amount of water that would need to be available to Nevada priorities two through eight to fulfill a given priority on this table.
Subcontracts are displayed below the Entitlement Holder and indented five spaces.
In a shortage, PPRs are delivered water in order of priority date regardless of state lines. PPRs are not included in this table, and they are accounted for in a separate PPR worksheet.
[1]2021 Decree Accounting values and Diversion/CU conversion ratios were used to estimate not specified and unquantified entitlements.
[2]Water for this entitlement is delivered through the Robert B. Griffith Project. 2021 Decree Accounting for the Robert B. Griffith Project and Las Vegas Wash return flows were used to estimate the consumptive use equivalent for these diversions.
[3]Though Boulder City's entitlement is delivered through the Robert B. Griffith Project, there are no return flows from Boulder City, so its consumptive use was assumed to be equivalent to diversion.
[4]This unlimited entitlement is estimated based on 2021 use, minus the Lake Mead National Recreation Area PPR.

E.3.2.4 California Assumptions

- Entitlements shown in **Table E-3** for California priorities one through three exclude the full volume of PPR entitlements held by those same parties, which are subject to a separate priority system (see **Section E.3.3**).
- Reclamation recognizes that the Quantification Settlement Agreement (QSA) and related agreements help California parties meet the water needs of PPRs by agreeing that certain parties to the Seven Party Agreement would make water available to satisfy the requirements of the PPR holders while keeping the priorities within the Seven Party Agreement intact. In addition, the QSA helped quantify entitlements in the Seven Party Agreement, which is necessary to model shortages.
    - The quantified entitlements in the QSA for the Imperial Irrigation District and the Coachella Valley Water District were modeled in the Shortage Allocation Model.
    - QSA transfers and exchanges were not modeled in the Shortage Allocation Model since the shortage levels simulated do not trigger QSA shortage provisions.
- Although the Metropolitan Water District of Southern California (MWD) has a fourth priority Seven Party Agreement entitlement of 550,000 af, MWD's consumptive use equivalent entitlement is calculated (for modeling purposes) to equal the balance of California's apportionment after full use of higher priority entitlements. During a shortage, MWD may acquire a minimum of 25,000 af from the Palo Verde Irrigation District, though this is not modeled in the Shortage Allocation Model.
- The Shortage Allocation Model attributes 93% of California DCP contributions to MWD and 7% of California DCP contributions to Coachella Valley Water District pursuant to a May 20, 2019, DCP Implementation Agreement Between Metropolitan Water District of Southern California and Coachella Valley Water District. No shortages from the 2007 Interim Guidelines are applicable to California.
- Entitlements associated with each California entitlement holder are available at: https://www.usbr.gov/lc/region/g4000/contracts/entitlements.html.
- Shortage to California entitlement holders, in this case comprised solely of DCP contributions, is calculated relative to their consumptive use entitlement (or equivalent).

Table E-3
Framework for Priority-Based Distribution of Available Water Within California

Priority	Entitlement Holder	Contract No.	Priority Date	Use	Diversion (AFY)	CU Entitlement (AFY)	Entitlements	
							CU or Estimated Equivalent (AFY)	Cumulative CU (AFY)
4th	The Metropolitan Water District of Southern California (MWD) (4)	I1r-645	1930, 1931	M&I	-	550,000	429,852	**1,705,724**
4th	**TOTAL**	-	-	-	**0**	**550,000**	**429,852**	-
3rd	Palo Verde Irrigation District (3b) – Lower Palo Verde Mesa Lands[1]	PVID20733C_P5	1933	Ag	≤16,000 acres	Unquantified	4,156	-
3rd	Coachella Valley Water District (CVWD) Total (3a)	I1r-781	1934	-	-	330,000	330,000	-
3rd	Imperial Irrigation District (IID) (3a)[2]	I1r-747	1932	-	-	615,000	615,000	-
3rd	**TOTAL[3]**	-	-	-	-	**945,000**	**949,156**	**1,275,872**
2nd	Yuma Project, Reservation Division (Bard Unit Only – Indian Unit Under PPRs)[4]	Water Certificates	1905	Ind./Ag	≤25,000 acres		3,459	-
2nd	**TOTAL**	-	-	-	**0**	**0**	**3,459**	**326,716**
1st	Palo Verde Irrigation District – Valley Lands (1)[5]	PVID20733C_P2	1933	Ag	≤104,500 acres	Unquantified	323,258	-
1st	**TOTAL**	-	-	-	**0**	**0**	**323,258**	**323,258**
-	**CALIFORNIA TOTALS**	-	-	-	-	-	**1,705,724**	-

Notes: CU means Consumptive Use; all units are in AFY (acre feet per year). The Cumulative CU column is included as a reference for the estimated amount of water that would need to be available to California priorities one through four to fulfill a given priority on this table.
Priorities are based on the California Seven Party Agreement, modified for the PPRs identified by the Consolidated Decree (which are accounted for in the PPRs tab).
Unless otherwise noted, 2021 Decree Accounting values and Diversion/CU conversion ratios were used to estimate not specified and unquantified entitlements.
PPRs are not included in this table, and they are accounted for in a separate PPR worksheet.
[1]PVID Lower Palo Verde Mesa Lands' 2022 Diversion of 9,134 af was assumed to be more representative of future conditions than the 2021 Diversion. The CU/Diversion ratio of about 0.455 for the entire PVID, based on 2021 accounting, was used to estimate the CU equivalent.
[2]Non-Colorado River water is pumped from the Lower Colorado Water Supply Project (LCWSP) wellfield and discharged into the All-American Canal for delivery to IID. IID forbears the consumptive use of an equivalent amount of Colorado River, up to a maximum of 10,000 af per year, to make such water available, via exchange, to the LCWSP beneficiaries (includes MWD and the City of Needles and its subcontractors). For purposes of the Shortage Allocation Model, the 10,000 af is included in IID's estimated CU equivalent; if the LCWSP was non-operational, that water would be diverted from the Colorado River by IID.
[3]QSA transfers and exchanges are not modeled in the Shortage Allocation Model since shortages to California are not triggered at the modeled shortage levels.
[4]The Yuma Project CU Estimated Equivalent is based on the 2021 CU from the Bard Unit, plus the amount conserved by the Bard Unit that was made available to MWD, minus the CU from PPR 28, which is accounted for in the PPRs tab. The Yuma Project Reservation Division Indian Unit is not accounted for here, since its use is fully satisfied by PPR 23, also listed in the PPRs tab.

E.3.2.5 Arizona Assumptions

- In 2007, consumptive use schedules were provided by the Arizona Department of Water Resources (ADWR) for use in the Shortage Allocation Model for the period 2008 through 2060. ADWR and Reclamation have not undertaken a process to update those schedules; shortage to Arizona entitlement holders is instead assessed relative to recent available data as described below for each priority.
- Central Arizona Project (CAP) excess and unused water contracts and mainstream unused apportionment or surplus (fifth and/or sixth priority) entitlements are not available in shortage and they are assumed to bear the remainder of any shortage not assigned to other parties within Arizona; they are assumed to be out of priority in all levels of shortage and they are not itemized.
- The Shortage Allocation Model does not attempt to redistribute water that may be available within a priority but is unordered by any specific entitlement holder.
- Entitlements associated with each Arizona entitlement holder are available at: https://www.usbr.gov/lc/region/g4000/contracts/entitlements.html.

Water available to entitlement holders in Arizona is distributed through each priority according to the following assumptions. These assumptions do not necessarily reflect operational procedure, but they are necessary to produce a general approximation of the effect of shortages on specific priorities and entitlement holders for the purpose of comparing alternatives in this SEIS.

E.3.2.5.1 Arizona Priority Two and Three Assumptions

Arizona priority two is for Secretarial Reservations and Perfected Rights established or effective prior to September 30, 1968. Arizona priority three is for entitlements pursuant to contracts between the US and water users in the State of Arizona executed on or before September 30, 1968. The second and third priorities are coequal.

Water supply to the Arizona second and third priorities is not projected to be affected at the specified levels of shortage and DCP contributions contemplated in the Shortage Allocation Model, because the Arizona fourth priority is not projected to be fully reduced. Thus it is unnecessary to analyze the relative priority of individual entitlements within the second and third priorities for purposes of assessing impacts within those priorities in this Appendix E; however, because information on the Arizona second and third priorities is included in the Shortage Allocation Model worksheets and second and third priority entitlements are enumerated in summary tables in this Appendix, modeling assumptions are described below.

The available supply to Arizona priorities two and three is calculated as the available supply to Arizona minus an average of the 4 highest of the last 5 years (2017–2021) of use by the first priority (PPR), or 519,154 AF. That supply is divided between priorities two and three in proportion to the sum of the consumptive use (or equivalent) entitlements within each priority: about 10 percent to priority two and about 90 percent to priority three. The 2007 Shortage Allocation Model did not distinguish between priority two and three supplies. The following assumptions for distribution within those priorities are intended to improve the accuracy of estimated impacts by considering contract-specific priority language.

Shortage is measured by the difference between water available to an entitlement during shortage and the 2021 adjusted consumptive use of that entitlement. Shortage is assumed to begin for priorities two and three when available supply is less than total 2021 adjusted consumptive use for both priorities, not reflecting the potential difference between orders and use. In addition, distributions of available water on the basis of entitlement may result in a shortage to certain entitlements and no shortage to others. The Shortage Allocation Model does not contain data for estimated orders in this priority or attempt to redistribute water that may be available, but unordered.

Water available to priority two is distributed among its five entitlements in proportion to their consumptive use (or equivalent) entitlement relative to the total for priority two.

Water available to priority three is distributed among its 28 entitlements in six groups according to project and/or division or pertinent contract terms. The alphanumeric sub-priority naming conventions for the six groups (shown in **Table E-4** below) are not operational or contractual designations, and they are only used as an organizational tool specific to this analysis. Five of the six groups are assumed to be coequal within priority three, and they are distributed water in proportion to the sum of the consumptive use (or equivalent) entitlements within each group, relative to the total for all five groups. They are discussed in detail in the sections that follow.

Table E-4
Framework for Priority-Based Distribution of Available Water Within Arizona Priorities 2 and 3

Priority	Water Allocation % by Priority	Sub-Priority	Project	Division	Water Allocation % by Project/Division	Entitlement Holder	Contract No.	Priority Date	Use	Entitlements	
										Diversion (AFY)	CU or *Estimated Equivalent* (AFY)
2nd	9.94%	N/A	N/A	N/A	N/A	Cibola National Wildlife Refuge	Secretarial Res.	8/21/1964	M&I	34,500	16,793
						Lake Mead National Recreation Area	Consolidated Decree	4/25/1930	M&I	unquantified	*306*
						Bureau of Reclamation – Davis Dam	Secretarial Res.	4/26/1941	M&I	100	*3*
						Imperial National Wildlife Refuge	Consolidated Decree	2/14/1941	M&I	28,000	23,000
						Havasu National Wildlife Refuge	Consolidated Decree	1/22/1941	M&I	41,839	37,399
		-	-	-	-	**P2 Total**	-	-	-	-	**77,501**
3rd	90.06%	3b	Boulder Canyon	-	Remainder	City of Yuma	14-06-W-106	11/12/1959	M&I	-	48,522
		-	-	-	-	**Project/Division Subtotal**	-	-	-	-	**48,522**
		3a5 Subordinate	Gila	Yuma Mesa	33.03%	Union Pacific Railroad (formerly Southern Pacific Co.)	14-06-303-1524	12/21/1959	M&I	48	*29*
						Kaman, Inc.	14-06-303-1555	12/2/1959	M&I	2	0
						Department of the Navy, MCAS	14-06-300-937	1/1/1959	M&I	3,000	*3,000*
						City of Yuma (cemetery)	14-06-303-1078	5/1/1956	M&I	60	0
						Yuma Mesa Fruit Growers' Association	14-06-303-1196	10/1/1956	M&I	15	0
						Desert Lawn Memorial Park Association	14-06-300-1079	5/1/1956	M&I	200	*140*
						Sturges, Harold	I76R-733	1/1/1952	Ag	335	*0*
						Sturges, Irma	I76R-735	1/1/1952	Ag	385	*0*
		3a5	Gila	Yuma Mesa	-	**Yuma Mesa Irrigation & Drainage District (10,000af M&I)**	5-07-30-W0095	5/26/1956	M&I/Ag	-	141,519
						Yuma Irrigation District (5,000af M&I)	5-07-30-W0093	7/23/1962	M&I/Ag	-	67,278
						North Gila Valley Irrigation and Drainage District (2,500af M&I)	5-07-30-W0094	5/12/1953	M&I/Ag	-	*3,920*
		-	-	-	-	**Project/Division Subtotal**	-	-	-	-	***215,886***
		3a4	Gila	Wellton-Mohawk	42.53%	**Wellton-Mohawk Irrigation and Drainage District (12,000af M&I)**	1-07-30-W0021	3/4/1952	M&I/Ag	-	278,000
		-	-	-	-	**Project/Division Subtotal**	-	-	-	-	***278,000***
		3a3	Various	-	11.73%	Ak-Chin Indian Community	1985 Settlement Contract	1/1/1956	M&I/Ag	50,000	*50,000*
						Chandler (Salt River Pima-Maricopa Exchange)	9-07-30-W0235	3/4/1952	M&I	4,278	*4,278*
						Gilbert (Salt River Pima-Maricopa Exchange)	9-07-30-W0241	3/4/1952	M&I	6,762	*6,762*
						Glendale (Salt River Pima-Maricopa Exchange)	9-07-30-W0236	3/4/1952	M&I	3,000	*3,000*
						Mesa (Salt River Pima-Maricopa Exchange)	9-07-30-W0239	3/4/1952	M&I	2,760	*2,760*
						Phoenix (Salt River Pima-Maricopa Exchange)	9-07-30-W0240	3/4/1952	M&I	5,000	*5,000*
						Scottsdale (Salt River Pima-Maricopa Exchange)	9-07-30-W0237	3/4/1952	M&I	100	*100*
						Tempe (Salt River Pima-Maricopa Exchange)	9-07-30-W0238	3/4/1952	M&I	100	*100*
						Department of the Army –– Yuma Proving Ground	I76r-696	6/12/1951	M&I	1,129	*1,129*
						Gila Monster Farms (formerly Sturges)	6-07-30-W0337	1/1/1952	Ag	6,285	3,516
		-	-	-	-	**Project/Division Subtotal**	-	-	-	-	***76,645***
		3a2 Subordinate	Yuma	-	10.69%	Yuma Union High School District	14-06-303-179	1/1/1953	M&I	200	*150*
		3a2	Yuma	-	-	**Yuma County Water Users' Association (14,701af M&I includes YAO)**	14-06-300-621 & Certificates	4/1/1957	M&I/Ag	unquantified	*69,690*
		-	-	-	-	**Project/Division Subtotal**	-	-	-	-	***69,840***
		3a1 Subordinate	Yuma Auxiliary	-	2.02%	University of Arizona	14-06-300-144	1/1/1954	Ag	1,088	*1,088*
						Camille Allec, Jr. (Formerly Yuma Mesa Grapefruit Company)	14-06-303-528	12/23/1953	Ag	120	0
		3a1				**Unit B Irrigation & Drainage District**	14-06-300-44	12/22/1952	Ag	unquantified	*12,145*
Grand Total	**100.00%**	-	-	-	-	**Project/Division Subtotal**	-	-	-	-	**13,233**
		-	-	-	-	**P3a Total**	-	-	-	-	**653,605**
		-	-	-	-	**P3 Total**	-	-	-	-	**702,127**
		-	-	-	-	**P 2 & 3 Grand Total**	-	-	-	-	**779,628**

The Yuma Mesa Division of the Gila Project

Approximately 33 percent of the available priority three water, up to the limit of the sum of the consumptive use (or equivalent) entitlements within the Division, is distributed among the Division's 11 entitlements. That water is first made available to Yuma Mesa Irrigation and Drainage District, Yuma Irrigation District, and North Gila Valley Irrigation and Drainage District coequally in proportion to their consumptive use entitlements.[3]

Any water remaining for the Division after satisfaction of the district contracts is made available to Union Pacific Railroad, Department of the Navy (Marine Corps Air Station), and Desert Lawn Memorial Park Association coequally in proportion to their consumptive use equivalent entitlements.[4]

The Kaman, City of Yuma (Cemetery), Yuma Mesa Fruit Growers Association, Harold Sturges, and Irma Sturges entitlements[4] are assumed to be unexercised, and they are not distributed water; they are shown with a consumptive use equivalent entitlement of zero.

The Wellton-Mohawk Division of the Gila Project

Approximately 43 percent of the available priority three water, up to the limit of Wellton-Mohawk Irrigation and Drainage District's consumptive use entitlement, is made available to the District.[3]

The Yuma Project

Approximately 11 percent of the available priority three water is first made available to the Yuma County Water Users Association up to the limit of its consumptive use equivalent entitlement. Any water remaining for the Yuma Project after satisfaction of the Association contract is made available to Yuma Union High School District.[4]

The Yuma Auxiliary Project

Approximately 2.0 percent of the available priority three water, up to the limit of the sum of the consumptive use equivalent entitlements within the Yuma Auxiliary Project, is distributed among the Yuma Auxiliary Project's three entitlements. That water is first made available to Unit B Irrigation and Drainage District up to the limit of its consumptive use equivalent entitlement. Any water remaining for the Yuma Auxiliary Project after satisfaction of the District contract is made available to the University of Arizona.[4] The Camille Allec, Jr. entitlement[4] is assumed to be unexercised and it is not distributed water; it is shown with a consumptive use equivalent entitlement of zero.

Various Entitlements

A group of 10 entitlements established under various authorities shares approximately 12 percent of the available priority three water, up to the limit of the sum of the consumptive use (or equivalent) entitlements within the group. Water is distributed to the Ak-Chin Indian Community; the Arizona cities of Chandler, Gilbert, Glendale, Mesa, Phoenix, Scottsdale, and Tempe; the Department of the Army (Yuma Proving Ground); and Gila Monster Farms coequally in proportion to their

[3] Domestic use within each district's entitlement is assumed to be subordinated to irrigation use in the district but is not itemized separately.

[4] Water use is subject to availability and is assumed not to be detrimental to water service for the project or prior appropriators.

consumptive use (or equivalent) entitlements. The distribution of water is stated in terms of quantities available at the mainstream point of diversion, and no assumptions are made about the further distribution of priority three water delivered through the CAP.

The City of Yuma
The City of Yuma gets a distribution of all remaining priority three water, up to the limit of its consumptive use entitlement (minus a portion assumed to be satisfied by PPR No. 21), reflecting that water delivery under its Contract No. 14-06-W-106 is subject to the prior fulfillment of contracts for the diversion of Colorado River water at Imperial Dam and for the delivery of such water through the Gila Gravity Main Canal or the All-American Canal for the irrigation of lands in the State of Arizona.

E.3.2.5.2 Arizona Priority Four Assumptions

Reclamation implemented the State of Arizona's August 6, 2009, Arizona Shortage Sharing Recommendation and the "pool" approach described by letter dated January 25, 2021, to inform approval of fourth priority water orders for operational years 2022 and 2023. Consistent with the Arizona mainstream Colorado River water priority system, the approach recognizes that the fourth priority Colorado River water entitlements of the P4(i) or 'mainstream' users and the CAP (P4(ii)) are coequal.

The Shortage Allocation Model uses the same fourth priority shortage sharing assumptions documented and described in:

- Reclamation's September 14, 2022, letter notifying interested parties of a Tier 2 Shortage Condition and required DCP contributions in operational year 2023 (Attachment E-1 to this Appendix E)
- Reclamation's September 28, 2022, letter to the Central Arizona Water Conservation District announcing the operational year 2023 Available CAP Supply (Attachment E-2 to this Appendix E)

Those assumptions result in the P4(i) pool receiving 9.85 percent of the Arizona fourth priority Colorado River water available under the modeled shortage scenarios, while the remainder is available for diversion as fourth priority water by the CAP to fulfill CAP contracts and subcontracts.

E.3.2.5.3 P4(i) (Mainstream) Framework and Assumptions

Water is distributed to each entitlement within the P4(i) pool in proportion to its diversion[5] volume relative to the current total for the pool, 151,274 AFY, which does not include outstanding ADWR recommendations, unallocated water, or the 3,500 AFY reserved for use in a future Navajo-Hopi

[5] Historically Arizona P4(i) entitlements have been quantified on a diversion basis. More recently some entitlements, currently including the Bureau of Land Management's and Town of Queen Creek's Arizona P4(i) entitlements, specify consumptive use volumes (consumptive use = diversions minus return flows). These entitlements are shown in Table E-5 as their diversion equivalents (consumptive use + return flows = diversion equivalent) for modeling purposes because distribution during shortage within the Arizona P4(i) pool currently is administered in proportion to all users' diversion volumes, not in proportion to consumptive use volumes, for uniformity and consistency. The diversion equivalency volumes listed in Table E-5 are necessary to analyze the distribution of the Arizona P4(i) entitlements with a uniform metric, do not modify the entitlements, and are consistent with applicable contracts and agency decision documents.

Indian water rights settlement in accordance with subsection 11.3 of the 2006 Arizona Water Settlement Agreement. (See **Table E-5**)

Contracts and subcontracts are itemized separately, meaning an entity's total modeled supply may be the sum of multiple distributions.

Table E-5
Framework for Priority-Based Distribution of Available Water Within Arizona P4(i) (Mainstream)

4th Priority Mainstream Entitlement Holders	4th Priority Contract Information							Initial Proportional Distribution of 4thth Priority Mainstream Available Supply
	Contract Number(s)	Date	Type of Use	-		-		
Arizona Game and Fish Commission	07-XX-30-W0509	2007	Irrigation	2,838.00	/	151,274	=	1.876%
Arizona State Land Department	4-07-30-W0317	1999	Irrigation	6,607.00	/	151,274	=	4.368%
Beattie Farms, Southwest	05-XX-30-W0446	2006	Irrigation	1,110.00	/	151,274	=	0.734%
Bishop, Alfred F. and Erma Jean Family Trust	21-XX-30-W0718	1983	Irrigation	420.00	/	151,274	=	0.278%
Cathcart, Bruce Y. and Lora M. and James Y. and Maria E.	21-XX-30-W0719	1983	Irrigation	126.00	/	151,274	=	0.083%
ChaCha, LLC	09-XX-30-W0539	2009	Irrigation	2,100.00	/	151,274	=	1.388%
Cibola Sportsman's Club, Inc.	21-XX-30-W0717	1983	Irrigation	216.00	/	151,274	=	0.143%
Cibola Valley Irrigation and Drainage District	2-07-30-W0028	1983	Irrigation/Domestic	7,442.52	/	151,274	=	4.920%
Cocopah Indian Reservation	Consolidated Decree in AZ v. CA	1974	Irrigation/Domestic	2,026.00	/	151,274	=	1.339%
Curtis, Armon	3-07-30-W0037	1983	Irrigation	300.00	/	151,274	=	0.198%
Gila Monster Farms, Inc.	6-07-30-W0337	1997	Irrigation	1,435.00	/	151,274	=	0.949%
GM Gabrych Family Limited Partnership	17-XX-30-W0628	2018	Irrigation	4,500.00	/	151,274	=	2.975%
GSC Farm, LLC[6]	13-XX-30-W0571	2013	Irrigation	69.93	/	151,274	=	1.926%
Hopi Tribe	04-XX-30-W0432	2004	Irrigation	4,278.00	/	151,274	=	2.828%
JRJ Partners, L.L.C.	06-XX-30-W0448	2007	Irrigation	1,080.00	/	151,274	=	0.714%
Mohave Valley Irrigation and Drainage District	14-06-W-204	1968	Irrigation/Domestic	35,060.00	/	151,274	=	23.176%
North Baja Pipeline, LLC	04-XX-30-W0433	2005	Irrigation/Domestic	480.00	/	151,274	=	0.317%
Ogram Boys Enterprises, Inc.	01-XX-30-W0402	2005	Irrigation	924.00	/	151,274	=	0.611%
Ott, Larry and Gina, and Lee C. and Candace M.	18-XX-30-W0639	2018	Irrigation	480.00	/	151,274	=	0.317%
Pasquinelli, Gary J. and Barbara J.	5-07-30-W0065	1986	Irrigation	486.00	/	151,274	=	0.321%
Red River Land Company, LLC	17-XX-30-W0630	2018	Irrigation	300.00	/	151,274	=	0.198%
Western Water, LLC	16-XX-30-W0619	2018	Irrigation	536.48	/	151,274	=	0.355%
Arizona State Land Department	7-07-30-W0358	2004	Domestic	1,534.00	/	151,274	=	1.014%
Arizona State Parks Board - Windsor Beach	7-07-30-W0364	1998	Domestic	90.00	/	151,274	=	0.059%
B&F Investment, LLC	06-XX-30-W0453	2006	Domestic	60.00	/	151,274	=	0.040%
Bullhead City	2-07-30-W0273	1994	Domestic	15,210.00	/	151,274	=	10.055%
Bullhead City (MCWA Subcontract)	Subcontract to 04-XX-30-W0431	2004	Domestic	2,139.00	/	151,274	=	1.414%
Bullhead City (MCWA Subcontract)	Subcontract No. 95-102 to 5-07-30-W0320	1995	Domestic	7,000.00	/	151,274	=	4.627%
Bureau of Land Management (diversion equivalent)	8-07-30-W0373	2000	Domestic	6,169.00	/	151,274	=	4.078%
Crystal Beach Water Conservation District	6-07-30-W0352	1997	Domestic	132.00	/	151,274	=	0.087%
Desert Lawn Memorial Park Association, Inc.	14-06-300-2587	1975	Domestic	360.00	/	151,274	=	0.238%
Ehrenburg Improvement District	8-07-30-W0006	1977	Domestic	735.00	/	151,274	=	0.486%
EPCOR Water Arizona Inc.	20-XX-30-W0690	2021	Domestic	1,874.00	/	151,274	=	1.239%
Fisher's Landing Water and Sewer Works, L.L.C.	06-XX-30-W0450	2006	Domestic	53.00	/	151,274	=	0.035%
Frontier Communications West Coast Inc.	14-06-300-2506	1974	Domestic	1.00	/	151,274	=	0.001%
Gold Dome Mining Corporation	0-07-30-W0250	1990	Domestic	7.00	/	151,274	=	0.005%

[6] On April 28, 2023, the US executed a partial assignment and transfer of Arizona P4(i) Colorado River water from GSC Farm, LLC to the Town of Queen Creek. Table E-5, which previously only included the GSC Farm, LLC entitlement, has been revised to include the assignment and transfer volumes, and the Shortage Allocation Model reflects an updated proportionate share of the Arizona P4(i) entitlement pool for both GSC Farm, LLC and the Town of Queen Creek (with the nontransferable historical return flow volume modeled in the diversion equivalent volume). Otherwise, the assignment and transfer does not modify the Arizona P4(i) pool volume under contract or the framework and assumptions discussed herein.

4th Priority Mainstream Entitlement Holders	4th Priority Contract Information				Initial Proportional Distribution of 4thth Priority Mainstream Available Supply			
	Contract Number(s)	Date	Type of Use					
Gold Standard Mines Corp.[7]	3-07-30-W0038	1983	Domestic	75.00	/	151,274	=	0.050%
Golden Shores Water Conservation District	9-07-30-W0203	1989	Domestic	2,000.00	/	151,274	=	1.322%
Hillcrest Water Company	5-07-30-W0078	1985	Domestic	84.00	/	151,274	=	0.056%
Lake Havasu City	3-07-30-W0039	1995	Domestic	19,192.70	/	151,274	=	12.687%
Lake Havasu City (MCWA Subcontract)	Subcontract to 04-XX-30-W0431	2004	Domestic	2,139.00	/	151,274	=	1.414%
Lake Havasu City (MCWA Subcontract)	Subcontract No. 95-101 to 5-07-30-W0320	1995	Domestic	7,250.00	/	151,274	=	4.793%
La Paz County	08-XX-30-W0530	2008	Domestic	350.00	/	151,274	=	0.231%
McAlister Family Trust	7-07-30-W0355	1998	Domestic	40.00	/	151,274	=	0.026%
Mohave Valley Irrigation and Drainage District (MCWA Subcontract)	Subcontract No. 09-101 to 5-07-30-W0320	1995	Domestic	1,250.00	/	151,274	=	0.826%
Mohave Water Conservation District	9-07-30-W0012	1979	Domestic	1,800.00	/	151,274	=	1.190%
Mohave Water Conservation District (MCWA Subcontract)	Subcontract No. 95-103 to 5-07-30-W0320	1995	Domestic	3,000.00	/	151,274	=	1.983%
Parker, Town of	2-07-30-W0025	1982	Domestic	1,030.00	/	151,274	=	0.681%
Quartzsite, Town of	7-07-30-W0353	1999	Domestic	1,070.00	/	151,274	=	0.707%
Queen Creek, Town of (mainstream diversion equivalent)	20-XX-30-W0689	2023	Domestic	2,843.37	/	151,274	=	1.880%
Roy, Estates of Anna R. and Edward P.	6-07-30-W0124	1986	Domestic	1.00	/	151,274	=	0.001%
Shepard Water Company, Incorporated	08-XX-30-W0535	2009	Domestic	50.00	/	151,274	=	0.033%
Somerton, City of	03-XX-30-W0419	2006	Domestic	750.00	/	151,274	=	0.496%
Springs Del Sol Domestic Water Improvement District	08-XX-30-W0524	2008	Domestic	100.00	/	151,274	=	0.066%
TV Marble Canyon AZ, LLC	5-07-30-W0322	1996	Domestic	70.00	/	151,274	=	0.046%
Total	-	-	-	**151,274**	-	-	-	**100%**

Each entitlement's proportional share of the available P4(i) supply is initially calculated on a diversion (or mainstream diversion equivalent) basis, then converted to a consumptive use equivalent using consumptive use to diversion ratios from the operational year 2021 *Colorado River Accounting and Water Use Report: Arizona, California, and Nevada*[8] or equivalent source data. Shortage is calculated as the difference between each entitlement's consumptive use equivalent supply and its 2021 consumptive use adjusted for participation in conservation programs (if applicable). The Shortage Allocation Model does not contain data for estimated orders in this priority, and therefore cannot illustrate the potential effect of the pool approach to redistributing water that may be available but unordered under any specific entitlement.

E.3.2.5.4 CAP Framework and Assumptions

In the Shortage Allocation Model, Arizona priority three Colorado River water entitlements delivered through the CAP are assumed to be fully satisfied consistent with their Colorado River third priority, and Arizona fourth priority (P4(i)) water transported through the CAP is assumed to be satisfied according to its priority. Terms and conditions for priority in case of shortage to the Available CAP Supply relate only to CAP fourth priority water (P4(ii)). The Shortage Allocation Model attempts to reflect the legislative and contractual terms and conditions applicable to CAP (P4(ii)) shortages, which shortage would impact the CAP P4(ii) distribution to CAP contractors and subcontractors.

[7] Contract No. 3-07-30-W0038 was terminated effective September 30, 2023.
[8] Internet website: https://www.usbr.gov/lc/region/g4000/4200Rpts/DecreeRpt/2021/2021.pdf, also known as Decree Accounting.

Levels of shortage to date have not required the implementation of shortage provisions in all CAP contracts, and their modeling should be understood as theoretical.

Available CAP Supply is first made available to Indian and Municipal & Industrial (M&I) Priority long-term contracts and subcontracts, and then to Non-Indian Agricultural (NIA) Priority long-term contracts and subcontracts. After all long-term CAP contracts and subcontracts are fulfilled[9], the remaining available water could be ordered under one-year excess contracts; however, none of the modeled shortage volumes are assumed to provide for enough available supply for excess contracts under the assumptions of the model.

The Shortage Allocation Model calculates Available CAP Supply as described in Reclamation's September 28, 2022, letter to the Central Arizona Water Conservation District (Attachment E-2 to this Appendix). A range of Available CAP Supply from zero to 1,251,317 AF, in rounded 10,000 af increments except at pivotal quantities, is presented in **Table E-6** below; all of these discrete levels of supply are contained within the Shortage Allocation Model, but because this SEIS only includes a distribution analysis over a specified range of shortage volumes, certain rows on **Table E-6** below an Available CAP Supply of 810,000 AF are not projected to be implicated under the assumptions of the Shortage Allocation Model. These rows are shaded gray to indicate inactivity in the analysis but are included in this Appendix E for constancy.

Table E-6
Discrete Levels and Distribution of Available CAP Supply Modeled in the Shortage Allocation Model

Available CAP Supply (AF)	Indian Priority Share	Indian Priority Supply (AF)	M&I Priority Supply (AF)	NIA Priority Supply (AF)
1,251,317	Full Supply	343,079	638,823	269,415
1,250,000	Full Supply	343,079	638,823	268,098
1,240,000	Full Supply	343,079	638,823	258,098
1,230,000	Full Supply	343,079	638,823	248,098
1,220,000	Full Supply	343,079	638,823	238,098
1,210,000	Full Supply	343,079	638,823	228,098
1,200,000	Full Supply	343,079	638,823	218,098
1,190,000	Full Supply	343,079	638,823	208,098
1,180,000	Full Supply	343,079	638,823	198,098
1,170,000	Full Supply	343,079	638,823	188,098
1,160,000	Full Supply	343,079	638,823	178,098
1,150,000	Full Supply	343,079	638,823	168,098
1,140,000	Full Supply	343,079	638,823	158,098
1,130,000	Full Supply	343,079	638,823	148,098
1,120,000	Full Supply	343,079	638,823	138,098
1,110,000	Full Supply	343,079	638,823	128,098

[9] Under Article 3.(b) of the 1985 Contract Between the United States and the Ak-Chin Indian Community to Provide Permanent Water and Settle Interim Water Rights, in any year in which sufficient surface water is available, the Secretary shall deliver certain additional water to the Ak-Chin Indian Community. Such water is assumed to be available if there is unused CAP water after CAP orders under long-term contracts and subcontracts are fulfilled; however, there is assumed to be no unused CAP water at the volumes of shortage modeled.

Available CAP Supply (AF)	Indian Priority Share	Indian Priority Supply (AF)	M&I Priority Supply (AF)	NIA Priority Supply (AF)
1,100,000	Full Supply	343,079	638,823	118,098
1,090,000	Full Supply	343,079	638,823	108,098
1,080,000	Full Supply	343,079	638,823	98,098
1,070,000	Full Supply	343,079	638,823	88,098
1,060,000	Full Supply	343,079	638,823	78,098
1,050,000	Full Supply	343,079	638,823	68,098
1,040,000	Full Supply	343,079	638,823	58,098
1,030,000	Full Supply	343,079	638,823	48,098
1,020,000	Full Supply	343,079	638,823	38,098
1,010,000	Full Supply	343,079	638,823	28,098
1,000,000	Full Supply	343,079	638,823	18,098
990,000	Full Supply	343,079	638,823	8,098
981,902	Formula	343,079	638,823	-
980,000	Formula	342,595	637,405	-
970,000	Formula	340,051	629,949	-
960,000	Formula	337,508	622,492	-
950,000	Formula	334,964	615,036	-
940,000	Formula	332,420	607,580	-
930,000	Formula	329,876	600,124	-
920,000	Formula	327,332	592,668	-
910,000	Formula	324,789	585,211	-
900,000	Formula	322,245	577,755	-
890,000	Formula	319,701	570,299	-
880,000	Formula	317,157	562,843	-
870,000	Formula	314,613	555,387	-
860,000	Formula	312,070	547,930	-
853,079	36.37518%	310,309	542,770	-
850,000	36.37518%	309,189	540,811	-
840,000	36.37518%	305,552	534,448	-
830,000	36.37518%	301,914	528,086	-
820,000	36.37518%	298,276	521,724	-
819,828	36.37518%	298,214	521,614	-
810,000	36.37518%	294,639	515,361	-
801,574	36.37518%	291,574	510,000	-
800,000	36.37518%	291,001	508,999	-
790,000	36.37518%	287,364	502,636	-
780,000	36.37518%	283,726	496,274	-
770,000	36.37518%	280,089	489,911	-
760,000	36.37518%	276,451	483,549	-
750,000	36.37518%	272,814	477,186	-
740,000	36.37518%	269,176	470,824	-
730,000	36.37518%	265,539	464,461	-
720,000	36.37518%	261,901	458,099	-
710,000	36.37518%	258,264	451,736	-
700,000	36.37518%	254,626	445,374	-
690,000	36.37518%	250,989	439,011	-

Available CAP Supply (AF)	Indian Priority Share	Indian Priority Supply (AF)	M&I Priority Supply (AF)	NIA Priority Supply (AF)
680,000	36.37518%	247,351	432,649	-
670,000	36.37518%	243,714	426,286	-
660,000	36.37518%	240,076	419,924	-
650,000	36.37518%	236,439	413,561	-
640,000	36.37518%	232,801	407,199	-
630,000	36.37518%	229,164	400,836	-
620,000	36.37518%	225,526	394,474	-
610,000	36.37518%	221,889	388,111	-
600,000	36.37518%	218,251	381,749	-
590,000	36.37518%	214,614	375,386	-
580,000	36.37518%	210,976	369,024	-
570,000	36.37518%	207,339	362,661	-
560,000	36.37518%	203,701	356,299	-
550,000	36.37518%	200,064	349,936	-
540,000	36.37518%	196,426	343,574	-
530,000	36.37518%	192,788	337,212	-
520,000	36.37518%	189,151	330,849	-
510,000	36.37518%	185,513	324,487	-
500,000	36.37518%	181,876	318,124	-
490,000	36.37518%	178,238	311,762	-
480,000	36.37518%	174,601	305,399	-
470,000	36.37518%	170,963	299,037	-
460,000	36.37518%	167,326	292,674	-
450,000	36.37518%	163,688	286,312	-
440,000	36.37518%	160,051	279,949	-
430,000	36.37518%	156,413	273,587	-
420,000	36.37518%	152,776	267,224	-
410,000	36.37518%	149,138	260,862	-
400,000	36.37518%	145,501	254,499	-
390,000	36.37518%	141,863	248,137	-
380,000	36.37518%	138,226	241,774	-
370,000	36.37518%	134,588	235,412	-
360,000	36.37518%	130,951	229,049	-
350,000	36.37518%	127,313	222,687	-
340,000	36.37518%	123,676	216,324	-
330,000	36.37518%	120,038	209,962	-
320,000	36.37518%	116,401	203,599	-
310,000	36.37518%	112,763	197,237	-
300,000	36.37518%	109,126	190,874	-
290,000	36.37518%	105,488	184,512	-
280,000	36.37518%	101,851	178,149	-
270,000	36.37518%	98,213	171,787	-
260,000	36.37518%	94,575	165,425	-
250,000	36.37518%	90,938	159,062	-
240,000	36.37518%	87,300	152,700	-
230,000	36.37518%	83,663	146,337	-

Available CAP Supply (AF)	Indian Priority Share	Indian Priority Supply (AF)	M&I Priority Supply (AF)	NIA Priority Supply (AF)
220,000	36.37518%	80,025	139,975	-
210,000	36.37518%	76,388	133,612	-
200,000	36.37518%	72,750	127,250	-
190,000	36.37518%	69,113	120,887	-
180,000	36.37518%	65,475	114,525	-
170,000	36.37518%	61,838	108,162	-
160,000	36.37518%	58,200	101,800	-
150,000	36.37518%	54,563	95,437	-
140,000	36.37518%	50,925	89,075	-
130,000	36.37518%	47,288	82,712	-
120,000	36.37518%	43,650	76,350	-
110,000	36.37518%	40,013	69,987	-
100,000	36.37518%	36,375	63,625	-
90,000	36.37518%	32,738	57,262	-
80,000	36.37518%	29,100	50,900	-
70,000	36.37518%	25,463	44,537	-
60,000	36.37518%	21,825	38,175	-
50,000	36.37518%	18,188	31,812	-
40,000	36.37518%	14,550	25,450	-
30,000	36.37518%	10,913	19,087	-
20,000	36.37518%	7,275	12,725	-
10,000	36.37518%	3,638	6,362	-
-	36.37518%	-	-	-

Through term-limited or temporary arrangements, to the extent that such arrangements may be allowed under specific long-term CAP contracts or other legal authority, CAP contractors and subcontractors may make their water available for end use by others. The Shortage Allocation Model does not replicate those arrangements, and it only provides approximate estimates at the contract or subcontract allocation level that interested parties could then consider in planning for administering their respective arrangements during shortage conditions. The CAP contractor, subcontractor, and/or parties to those arrangements would have specific decisions to make during shortage conditions to administer those arrangements that Reclamation cannot predict with sufficient certainty to analyze in this SEIS.

The Shortage Allocation Model does not attempt to replicate the provisions of the CAP priority system that provide for unordered water to be made available to other contractors or subcontractors within a priority, or unordered water from one priority to be made available to another.

Shortage volumes are calculated as the difference between available water distributed to each allocation and the 2024–2026 projected water orders associated with that allocation, as compiled for the 2023 Arizona DCP Implementation Plan Exhibit 7.1 dated December 15, 2022[10]. Allocations which are currently unused are shown as bearing no shortage, and unallocated or water not yet

[10] Internet website: https://new.azwater.gov/sites/default/files/media/2022.12.15%20Exhibit%207.1%20Public%20Posting.pdf.

placed under contract (including the Secretary's retention of 6,411 AFY of CAP NIA Priority water for use for a future water rights settlement agreement approved by an Act of Congress that settles the Navajo Nation's claims to water in Arizona, consistent with the Arizona Water Settlements Act of 2004, section 104(a)) is not reflected in the distribution of available water and is not shown as bearing shortage. These modeling assumptions reflect only that it cannot be speculated when or whether such water or volumes may be allocated or placed under contract but are not intended to preclude allocations or the entry of contracts during the remainder of the interim period consistent with applicable law and authority.

CAP Indian Priority Assumptions

The overall deliverable quantity of Indian Priority supply is calculated as authorized in the 2004 Arizona Water Settlements Act (AWSA) (Public Law 108-451) section 104(d). The available Indian Priority supply is then distributed as described in applicable law, contracts, and subcontracts and as noted below.

Shortage to the Ak-Chin Indian Community's Indian Priority irrigation allocation is shown at the allocation level, and it does not reflect the conditional entitlement to a portion of that allocation that is held by the San Carlos Apache Tribe. In addition, the shortages attributed to Indian Priority allocations, pursuant to the internal priority system of the Indian Priority pool, do not account for the existence of external arrangements and commitments that would affect the ultimate impacts of shortage. For example, the ultimate impact of shortage may fall in whole or in part on a lessor who has leased a portion of a contractor's Indian Priority water, but the terms and duration of such leasing arrangements are varied, and the arrangement does not change the underlying allocation-holder. Shortages attributed to Indian Priority allocations in the Shortage Allocation Model form the basis for additional analyses on a case-by-case basis as necessary to administer shortage consistent with applicable contracts and subcontracts.

Further, the Shortage Allocation Model does not analyze any applicable Secretarial obligations to deliver certain contractors or subcontractors other sources of water in any given year, which might have the effect of offsetting or negating the numerical impacts shown to specific Indian Priority pool allocations and could appear to understate the regional effect of a Colorado River shortage. This SEIS presents the worst-case impacts of a regional loss of supply relative to the quantified volumes of Colorado River water the Secretary has allocated and contracted for and actively administers, rather than attempting to analyze and monetize the loss relative to all sources of water supply any given water user may have available.

For the purpose of calculating water available to individual Indian Priority allocations, the Indian Priority supply is distributed under a set of assumptions consistent with AWSA section 104(d) and the approach described in Exhibit 5.3.4.1 to the Tohono O'odham Settlement Agreement[11], *Secretary's Approach for Determining the Amount of Water Available to the Nation During a Time of Shortage Under 1980 Contract*, except as provided in the following paragraph.

[11] Attachment E-3 to this Appendix E

Calculations for the distribution of water are performed as though all Indian Priority entitlements were fully used during the most recent operational year which was not a Time of Shortage.

These assumptions yield the distribution of available Indian Priority water shown in **Table E-7** for a range of discrete Available CAP Supplies. All of these discrete levels of supply are contained within the Shortage Allocation Model, but because this SEIS only includes a distribution analysis over a specified range of shortage volumes, certain rows on **Table E-7** below a CAP Available Supply of 810,000 AF are not projected to be implicated under the assumptions of the Shortage Allocation Model. These rows are shaded gray to indicate inactivity in the analysis but are included in this Appendix E for constancy.

Table E-7
Distribution of CAP Indian Priority Supply

-	Post-AWSA Contracts						Pre-AWSA Contracts									
Available CAP Supply (AF)	Indian Priority Share	Indian Priority Supply (AF)	Distribution to Contractors (AF)				Indian Priority Share	Indian Priority Supply (AF)	Distribution to Contractors (AF)							
			Gila River Indian Community	Tohono O'odham Nation (SX & ST)	White Mountain Apache Tribe	Scottsdale (Yavapai Prescott Indian Tribe)			Ak-Chin Indian Community	Fort McDowell Yavapai Nation	Pascua Yaqui Tribe	San Carlos Apache Tribe	Salt River Pima-Maricopa Indian Community	Sif Oidak District	Tonto Apache Tribe	Yavapai Apache Nation
990,000	Full Supply	343,079	191,200	37,800	1,218	500	Full Supply	343,079	58,300	18,233	500	12,700	13,300	8,000	128	1,200
981,902	Formula	343,079	191,200	37,800	1,218	500	Full Supply	343,079	58,300	18,233	500	12,700	13,300	8,000	128	1,200
980,000	Formula	342,595	190,716	37,800	1,218	500	Full Supply	343,079	58,300	18,233	500	12,700	13,300	8,000	128	1,200
970,000	Formula	340,051	188,172	37,800	1,218	500	Full Supply	343,079	58,300	18,233	500	12,700	13,300	8,000	128	1,200
960,000	Formula	337,508	185,629	37,800	1,218	500	Full Supply	343,079	58,300	18,233	500	12,700	13,300	8,000	128	1,200
950,000	Formula	334,964	183,085	37,800	1,218	500	Full Supply	343,079	58,300	18,233	500	12,700	13,300	8,000	128	1,200
940,000	Formula	332,420	180,541	37,800	1,218	500	Full Supply	343,079	58,300	18,233	500	12,700	13,300	8,000	128	1,200
930,000	Formula	329,876	177,997	37,800	1,218	500	Full Supply	343,079	58,300	18,233	500	12,700	13,300	8,000	128	1,200
920,000	Formula	327,332	175,453	37,800	1,218	500	Full Supply	343,079	58,300	18,233	500	12,700	13,300	8,000	128	1,200
910,000	Formula	324,789	172,910	37,800	1,218	500	Full Supply	343,079	58,300	18,233	500	12,700	13,300	8,000	128	1,200
900,000	Formula	322,245	170,366	37,800	1,218	500	Full Supply	343,079	58,300	18,233	500	12,700	13,300	8,000	128	1,200
890,000	Formula	319,701	167,822	37,800	1,218	500	Full Supply	343,079	58,300	18,233	500	12,700	13,300	8,000	128	1,200
880,000	Formula	317,157	165,278	37,800	1,218	500	Full Supply	343,079	58,300	18,233	500	12,700	13,300	8,000	128	1,200
870,000	Formula	314,613	162,734	37,800	1,218	500	Full Supply	343,079	58,300	18,233	500	12,700	13,300	8,000	128	1,200
860,000	Formula	312,070	160,191	37,800	1,218	500	Full Supply	343,079	58,300	18,233	500	12,700	13,300	8,000	128	1,200
853,079	36.37518%	310,309	158,430	37,800	1,218	500	Imputed	343,079	58,300	18,233	500	12,700	13,300	8,000	128	1,200
850,000	36.37518%	309,189	157,802	37,800	1,218	500	Imputed	340,000	57,951	18,233	500	12,684	13,220	7,952	128	1,200
840,000	36.37518%	305,552	155,762	37,800	1,218	500	Imputed	330,000	56,820	18,233	500	12,631	12,962	7,797	128	1,200
830,000	36.37518%	301,914	153,723	37,800	1,218	500	Imputed	320,000	55,688	18,233	500	12,579	12,704	7,642	128	1,200
820,000	36.37518%	298,276	151,683	37,800	1,218	500	Imputed	310,000	54,556	18,233	500	12,527	12,446	7,486	128	1,200
819,828	36.37518%	298,214	151,648	37,800	1,218	500	Imputed	309,828	54,536	18,233	500	12,526	12,441	7,484	128	1,200
810,000	36.37518%	294,639	149,644	37,800	1,218	500	Imputed	300,000	53,424	18,233	500	12,474	12,188	7,331	128	1,200
801,574	36.37518%	291,574	147,925	37,800	1,218	500	Either	291,574	52,470	18,233	500	12,430	11,970	7,200	128	1,200
800,000	36.37518%	291,001	147,635	37,726	1,216	499	36.37518%	291,001	52,367	18,197	499	12,406	11,946	7,186	128	1,198
790,000	36.37518%	287,364	145,789	37,254	1,200	493	36.37518%	287,364	51,712	17,970	493	12,251	11,797	7,096	126	1,183
780,000	36.37518%	283,726	143,944	36,783	1,185	487	36.37518%	283,726	51,058	17,742	487	12,095	11,648	7,006	125	1,168
770,000	36.37518%	280,089	142,098	36,311	1,170	480	36.37518%	280,089	50,403	17,515	480	11,940	11,499	6,916	123	1,153

	Post-AWSA Contracts						Pre-AWSA Contracts									
			Distribution to Contractors (AF)						Distribution to Contractors (AF)							
Available CAP Supply (AF)	Indian Priority Share	Indian Priority Supply (AF)	Gila River Indian Community	Tohono O'odham Nation (SX & ST)	White Mountain Apache Tribe	Scottsdale (Yavapai Prescott Indian Tribe)	Indian Priority Share	Indian Priority Supply (AF)	Ak-Chin Indian Community	Fort McDowell Yavapai Nation	Pascua Yaqui Tribe	San Carlos Apache Tribe	Salt River Pima-Maricopa Indian Community	Sif Oidak District	Tonto Apache Tribe	Yavapai Apache Nation
760,000	36.37518%	276,451	140,253	35,839	1,155	474	36.37518%	276,451	49,749	17,287	474	11,785	11,349	6,827	121	1,138
750,000	36.37518%	272,814	138,407	35,368	1,140	468	36.37518%	272,814	49,094	17,060	468	11,630	11,200	6,737	120	1,123
740,000	36.37518%	269,176	136,562	34,896	1,124	462	36.37518%	269,176	48,439	16,832	462	11,475	11,051	6,647	118	1,108
730,000	36.37518%	265,539	134,717	34,425	1,109	455	36.37518%	265,539	47,785	16,605	455	11,320	10,901	6,557	117	1,093
720,000	36.37518%	261,901	132,871	33,953	1,094	449	36.37518%	261,901	47,130	16,377	449	11,165	10,752	6,467	115	1,078
710,000	36.37518%	258,264	131,026	33,482	1,079	443	36.37518%	258,264	46,476	16,150	443	11,010	10,603	6,377	113	1,063
700,000	36.37518%	254,626	129,180	33,010	1,064	437	36.37518%	254,626	45,821	15,923	437	10,855	10,453	6,288	112	1,048
690,000	36.37518%	250,989	127,335	32,538	1,048	430	36.37518%	250,989	45,167	15,695	430	10,700	10,304	6,198	110	1,033
680,000	36.37518%	247,351	125,489	32,067	1,033	424	36.37518%	247,351	44,512	15,468	424	10,545	10,155	6,108	109	1,018
670,000	36.37518%	243,714	123,644	31,595	1,018	418	36.37518%	243,714	43,857	15,240	418	10,390	10,005	6,018	107	1,003
660,000	36.37518%	240,076	121,798	31,124	1,003	412	36.37518%	240,076	43,203	15,013	412	10,235	9,856	5,928	105	988
650,000	36.37518%	236,439	119,953	30,652	988	405	36.37518%	236,439	42,548	14,785	405	10,080	9,707	5,839	104	973
640,000	36.37518%	232,801	118,108	30,181	972	399	36.37518%	232,801	41,894	14,558	399	9,924	9,557	5,749	102	958
630,000	36.37518%	229,164	116,262	29,709	957	393	36.37518%	229,164	41,239	14,330	393	9,769	9,408	5,659	101	943
620,000	36.37518%	225,526	114,417	29,237	942	387	36.37518%	225,526	40,584	14,103	387	9,614	9,259	5,569	99	928
610,000	36.37518%	221,889	112,571	28,766	927	381	36.37518%	221,889	39,930	13,875	381	9,459	9,109	5,479	97	913
600,000	36.37518%	218,251	110,726	28,294	912	374	36.37518%	218,251	39,275	13,648	374	9,304	8,960	5,389	96	898
590,000	36.37518%	214,614	108,880	27,823	897	368	36.37518%	214,614	38,621	13,420	368	9,149	8,811	5,300	94	883
580,000	36.37518%	210,976	107,035	27,351	881	362	36.37518%	210,976	37,966	13,193	362	8,994	8,661	5,210	93	868
570,000	36.37518%	207,339	105,190	26,880	866	356	36.37518%	207,339	37,311	12,966	356	8,839	8,512	5,120	91	853
560,000	36.37518%	203,701	103,344	26,408	851	349	36.37518%	203,701	36,657	12,738	349	8,684	8,363	5,030	89	838
550,000	36.37518%	200,064	101,499	25,936	836	343	36.37518%	200,064	36,002	12,511	343	8,529	8,213	4,940	88	823
540,000	36.37518%	196,426	99,653	25,465	821	337	36.37518%	196,426	35,348	12,283	337	8,374	8,064	4,850	86	808
530,000	36.37518%	192,788	97,808	24,993	805	331	36.37518%	192,788	34,693	12,056	331	8,219	7,915	4,761	85	793
520,000	36.37518%	189,151	95,962	24,522	790	324	36.37518%	189,151	34,039	11,828	324	8,064	7,765	4,671	83	778
510,000	36.37518%	185,513	94,117	24,050	775	318	36.37518%	185,513	33,384	11,601	318	7,909	7,616	4,581	81	763
500,000	36.37518%	181,876	92,272	23,579	760	312	36.37518%	181,876	32,729	11,373	312	7,753	7,467	4,491	80	749
490,000	36.37518%	178,238	90,426	23,107	745	306	36.37518%	178,238	32,075	11,146	306	7,598	7,317	4,401	78	734
480,000	36.37518%	174,601	88,581	22,635	729	299	36.37518%	174,601	31,420	10,918	299	7,443	7,168	4,312	77	719
470,000	36.37518%	170,963	86,735	22,164	714	293	36.37518%	170,963	30,766	10,691	293	7,288	7,019	4,222	75	704
460,000	36.37518%	167,326	84,890	21,692	699	287	36.37518%	167,326	30,111	10,463	287	7,133	6,869	4,132	73	689
450,000	36.37518%	163,688	83,044	21,221	684	281	36.37518%	163,688	29,456	10,236	281	6,978	6,720	4,042	72	674
440,000	36.37518%	160,051	81,199	20,749	669	274	36.37518%	160,051	28,802	10,008	274	6,823	6,571	3,952	70	659
430,000	36.37518%	156,413	79,354	20,278	653	268	36.37518%	156,413	28,147	9,781	268	6,668	6,421	3,862	69	644
420,000	36.37518%	152,776	77,508	19,806	638	262	36.37518%	152,776	27,493	9,554	262	6,513	6,272	3,773	67	629
410,000	36.37518%	149,138	75,663	19,334	623	256	36.37518%	149,138	26,838	9,326	256	6,358	6,123	3,683	65	614
400,000	36.37518%	145,501	73,817	18,863	608	250	36.37518%	145,501	26,183	9,099	250	6,203	5,973	3,593	64	599
390,000	36.37518%	141,863	71,972	18,391	593	243	36.37518%	141,863	25,529	8,871	243	6,048	5,824	3,503	62	584
380,000	36.37518%	138,226	70,126	17,920	577	237	36.37518%	138,226	24,874	8,644	237	5,893	5,675	3,413	61	569
370,000	36.37518%	134,588	68,281	17,448	562	231	36.37518%	134,588	24,220	8,416	231	5,738	5,525	3,323	59	554

-	Post-AWSA Contracts						Pre-AWSA Contracts									
Available CAP Supply (AF)	Indian Priority Share	Indian Priority Supply (AF)	Distribution to Contractors (AF)				Indian Priority Share	Indian Priority Supply (AF)	Distribution to Contractors (AF)							
			Gila River Indian Community	Tohono O'odham Nation (SX & ST)	White Mountain Apache Tribe	Scottsdale (Yavapai Prescott Indian Tribe)			Ak-Chin Indian Community	Fort McDowell Yavapai Nation	Pascua Yaqui Tribe	San Carlos Apache Tribe	Salt River Pima-Maricopa Indian Community	Sif Oidak District	Tonto Apache Tribe	Yavapai Apache Nation
360,000	36.37518%	130,951	66,436	16,977	547	225	36.37518%	130,951	23,565	8,189	225	5,583	5,376	3,234	57	539
350,000	36.37518%	127,313	64,590	16,505	532	218	36.37518%	127,313	22,911	7,961	218	5,427	5,227	3,144	56	524
340,000	36.37518%	123,676	62,745	16,033	517	212	36.37518%	123,676	22,256	7,734	212	5,272	5,077	3,054	54	509
330,000	36.37518%	120,038	60,899	15,562	501	206	36.37518%	120,038	21,601	7,506	206	5,117	4,928	2,964	53	494
320,000	36.37518%	116,401	59,054	15,090	486	200	36.37518%	116,401	20,947	7,279	200	4,962	4,779	2,874	51	479
310,000	36.37518%	112,763	57,208	14,619	471	193	36.37518%	112,763	20,292	7,051	193	4,807	4,629	2,785	50	464
300,000	36.37518%	109,126	55,363	14,147	456	187	36.37518%	109,126	19,638	6,824	187	4,652	4,480	2,695	48	449
290,000	36.37518%	105,488	53,518	13,676	441	181	36.37518%	105,488	18,983	6,596	181	4,497	4,331	2,605	46	434
280,000	36.37518%	101,851	51,672	13,204	425	175	36.37518%	101,851	18,328	6,369	175	4,342	4,181	2,515	45	419
270,000	36.37518%	98,213	49,827	12,732	410	168	36.37518%	98,213	17,674	6,142	168	4,187	4,032	2,425	43	404
260,000	36.37518%	94,575	47,981	12,261	395	162	36.37518%	94,575	17,019	5,914	162	4,032	3,883	2,335	42	389
250,000	36.37518%	90,938	46,136	11,789	380	156	36.37518%	90,938	16,365	5,687	156	3,877	3,733	2,246	40	374
240,000	36.37518%	87,300	44,290	11,318	365	150	36.37518%	87,300	15,710	5,459	150	3,722	3,584	2,156	38	359
230,000	36.37518%	83,663	42,445	10,846	349	143	36.37518%	83,663	15,056	5,232	143	3,567	3,435	2,066	37	344
220,000	36.37518%	80,025	40,599	10,375	334	137	36.37518%	80,025	14,401	5,004	137	3,412	3,285	1,976	35	329
210,000	36.37518%	76,388	38,754	9,903	319	131	36.37518%	76,388	13,746	4,777	131	3,256	3,136	1,886	34	314
200,000	36.37518%	72,750	36,909	9,431	304	125	36.37518%	72,750	13,092	4,549	125	3,101	2,987	1,796	32	299
190,000	36.37518%	69,113	35,063	8,960	289	119	36.37518%	69,113	12,437	4,322	119	2,946	2,837	1,707	30	284
180,000	36.37518%	65,475	33,218	8,488	274	112	36.37518%	65,475	11,783	4,094	112	2,791	2,688	1,617	29	269
170,000	36.37518%	61,838	31,372	8,017	258	106	36.37518%	61,838	11,128	3,867	106	2,636	2,539	1,527	27	254
160,000	36.37518%	58,200	29,527	7,545	243	100	36.37518%	58,200	10,473	3,639	100	2,481	2,389	1,437	26	240
150,000	36.37518%	54,563	27,681	7,074	228	94	36.37518%	54,563	9,819	3,412	94	2,326	2,240	1,347	24	225
140,000	36.37518%	50,925	25,836	6,602	213	87	36.37518%	50,925	9,164	3,185	87	2,171	2,091	1,258	22	210
130,000	36.37518%	47,288	23,991	6,130	198	81	36.37518%	47,288	8,510	2,957	81	2,016	1,941	1,168	21	195
120,000	36.37518%	43,650	22,145	5,659	182	75	36.37518%	43,650	7,855	2,730	75	1,861	1,792	1,078	19	180
110,000	36.37518%	40,013	20,300	5,187	167	69	36.37518%	40,013	7,200	2,502	69	1,706	1,643	988	18	165
100,000	36.37518%	36,375	18,454	4,716	152	62	36.37518%	36,375	6,546	2,275	62	1,551	1,493	898	16	150
90,000	36.37518%	32,738	16,609	4,244	137	56	36.37518%	32,738	5,891	2,047	56	1,396	1,344	808	14	135
80,000	36.37518%	29,100	14,763	3,773	122	50	36.37518%	29,100	5,237	1,820	50	1,241	1,195	719	13	120
70,000	36.37518%	25,463	12,918	3,301	106	44	36.37518%	25,463	4,582	1,592	44	1,085	1,045	629	11	105
60,000	36.37518%	21,825	11,073	2,829	91	37	36.37518%	21,825	3,928	1,365	37	930	896	539	10	90
50,000	36.37518%	18,188	9,227	2,358	76	31	36.37518%	18,188	3,273	1,137	31	775	747	449	8	75
40,000	36.37518%	14,550	7,382	1,886	61	25	36.37518%	14,550	2,618	910	25	620	597	359	6	60
30,000	36.37518%	10,913	5,536	1,415	46	19	36.37518%	10,913	1,964	682	19	465	448	269	5	45
20,000	36.37518%	7,275	3,691	943	30	12	36.37518%	7,275	1,309	455	12	310	299	180	3	30
10,000	36.37518%	3,638	1,845	472	15	6	36.37518%	3,638	655	227	6	155	149	90	2	15
-	36.37518%	-	-	-	-	-	36.37518%	-	-	-	-	-	-	-	-	-

CAP M&I Priority Assumptions

The M&I Priority supply is calculated as the remainder of Available CAP Supply (up to 981,902 AF) not made available for delivery as Indian Priority supply. When Available CAP Supply equals or exceeds 981,902 AF, the Indian and M&I Priorities both receive a full supply.

The available M&I Priority supply is distributed to each allocation in proportion to 2024–2026 projected water orders, relative to total projected orders for M&I Priority water. (The proportions are shown below in **Table E-8**) This assumption is consistent with a joint consultation undertaken by Reclamation and the Central Arizona Water Conservation District (CAWCD) with M&I Priority water users in 2022.[12]

Table E-8
Distribution of CAP M&I Priority Water in Proportion to 2024-2026 Orders

M&I Contractor or Subcontractor	2024-2026 Orders (AF)	Percentage of Orders
Freeport-Morenci (SCAT Lease)	5,645	0.94%
Scottsdale (SCAT Lease)	12,500	2.07%
ASARCO	21,000	3.48%
Avondale	5,416	0.90%
AZSLD	5,200	0.86%
AZWC, Casa Grande	8,884	1.47%
AZWC, Coolidge	2,000	0.33%
AZWC, Superstition	6,285	1.04%
AZWC, White Tank	968	0.16%
Buckeye	223	0.04%
CAGRD	6,426	1.07%
Carefree WC	886	0.15%
Cave Creek	2,606	0.43%
Chandler	8,654	1.44%
Chaparral City WC	8,909	1.48%
Circle City	-	0.00%
El Mirage	508	0.08%
Eloy	2,171	0.36%
EPCOR, AF	11,093	1.84%
EPCOR, PV	3,231	0.54%
EPCOR, SC	4,189	0.70%
EPCOR, SCW	2,372	0.39%
Florence	2,048	0.34%
Freeport-Miami	2,906	0.48%
FWID	2,854	0.47%
Gilbert	7,235	1.20%
Glendale	17,236	2.86%
Goodyear	10,742	1.78%
Greater Tonopah, Water Utility	64	0.01%

[12] As documented by Letter Agreement No. 22-XX-30-W0743LA between Reclamation and CAWCD, dated May 15, 2023.

M&I Contractor or Subcontractor	2024-2026 Orders (AF)	Percentage of Orders
Green Valley CWC	-	0.00%
Green Valley DWID	-	0.00%
Marana	2,336	0.39%
Maricopa Cty P&R	665	0.11%
Mesa	43,503	7.22%
Metro DWID (Includes ICS Creation)	13,460	2.23%
Oro Valley	10,305	1.71%
Peoria	27,121	4.50%
Phoenix	122,204	20.28%
Pine	-	0.00%
Queen Creek	495	0.08%
Rio Verde Utilities	812	0.13%
San Tan ID	-	0.00%
Scottsdale	52,810	8.76%
Spanish Trail WC	3,037	0.50%
Surprise	10,249	1.70%
Tempe	4,315	0.72%
Tonopah	-	0.00%
Tonto Hills DWID	71	0.01%
Tucson	144,191	23.93%
Vail WC	1,857	0.31%
WUCFD, Apache Junction	2,919	0.48%
TOTAL	**602,601**	**100.00%**

CAP NIA Priority Assumptions

Only when Available CAP Supply is calculated to be greater than 981,902 AF, the NIA Priority supply is calculated as the difference between Available CAP Supply and the sum of the Indian and M&I Priority entitlements. NIA Priority supply is assumed not to be available when Available CAP Supply is less than 981,902 AF.

The Shortage Allocation Model does not contain data for CAP water use in the most recent year that a full NIA Priority supply (inclusive of NIA-A and NIA-B) was available. However, in this modeling, available water is distributed first to NIA Priority contractors and subcontractors assumed to have used CAP NIA Priority Water in the last year in which the Available CAP Supply was sufficient to fill all orders for CAP NIA Priority Water (NIA-A) (**Table E-9**), before available water is distributed to the other NIA Priority contracts and subcontracts (NIA-B) (**Table E-10**).[13] Within each sub-priority, available water is modeled as being distributed to each allocation in proportion to 2024-2026 projected water orders, relative to total projected orders for the sub-priority.

[13] The CAP NIA Priority Water is distributed in accordance with the CAP NIA Priority Water subcontracts, in particular paragraph 4.7(b)-(c) of such subcontracts, and the settlement agreements with the Gila River Indian Community and the Tohono O'odham Nation. The Hualapai Tribe's CAP NIA Priority water will be distributed in accordance with its settlement agreement (pending enforceability) and the Hualapai Tribe Water Rights Settlement Act of 2022, in particular section 13.

Table E-9
Distribution of CAP NIA-A Priority Water in Proportion to 2024-2026 Orders

NIA A Priority Contractor or Subcontractor	2024-2026 Orders (AF)	Percentage of Orders
GRIC (own account)	102,415	50.93%
Tohono O'odham - Schuk Toak & San Xavier	28,200	14.02%
CAGRD [GRIC]	18,185	9.04%
Phoenix	37,280	18.54%
Chandler	3,924	1.95%
Gilbert	1,537	0.76%
Glendale	682	0.34%
Mesa	5,551	2.76%
Scottsdale	3,306	1.64%
Tempe	23	0.01%
TOTAL	**201,103**	**100.00%**

Table E-10
Distribution of CAP NIA-B Priority Water in Proportion to 2024–2026 Orders

NIA B Priority Contractor or Subcontractor	2024-2026 Orders (AF)	Percentage of Orders
WMAT	-	0.00%
Buckeye	2,786	6.26%
CAGRD	18,185	40.84%
Carefree WC	112	0.25%
Cave Creek	386	0.87%
El Mirage	1,318	2.96%
EPCOR, San Tan (ST)	3,217	7.22%
Freeport	5,678	12.75%
Gilbert	1,832	4.11%
Marana	515	1.16%
Queen Creek	4,162	9.35%
Resolution Copper	2,238	5.03%
Rosemont Copper	1,124	2.52%
SRP	2,160	4.85%
WUCFD, Apache Junction	817	1.83%
TOTAL	**44,530**	**100.00%**

E.3.3 Present Perfected Rights Assumptions

This analysis does not result in a reduction to PPRs according to the fill order provided below in **Table E-11** (bottom up), derived from Paragraph 5 of the Appendix to the Consolidated Decree. As set forth in the Consolidated Decree, the PPR priority system is administered without regard to state lines. This information is included for reference in cases where the Shortage Allocation Model distinguished PPRs from other priorities of water held by a single entitlement holder. PPRs are also enumerated in summary tables but are shown as bearing no shortage under the alternatives.

Table E-11
Present Perfected Right Summary and Assumed Fill Order

Entitlements Arizona, California, and Nevada Summary	CU Equivalent (AF)	Diversion (AF)
Arizona Total	567,499	1,077,971
California Total	2,694,276	3,019,573
Nevada Total	8,697	13,034
Total	3,270,473	4,110,578

Entitlement Holders	CU Equivalent (AF)†	Diversion (AF)	PPR No.	Date	State	Category	Cumulative Consumptive Use Equivalent (AF)
Lake Mead National Recreation Area (Overton Area, EO 5105)	300	500	82	1929	NV	Federal Establishments & Water Projects	3,270,473
Molina	64	318	15	1928	AZ	Miscellaneous	3,270,173
Sonny Gowan (Grannis)	108	180	32	1928	CA	Miscellaneous	3,270,109
Diehl*	0.6	1	59	1928	CA	Miscellaneous	3,270,001
Stallard*	0.6	1	66	1928	CA	Miscellaneous	3,270,000
Estrada*	0.6	1	77	1928	CA	Miscellaneous	3,269,999
Corrington*	0.6	1	79	1928	CA	Miscellaneous	3,269,999
Tolliver*	0.6	1	80	1928	CA	Miscellaneous	3,269,998
Randolph*	0.6	1	65	1926	CA	Miscellaneous	3,269,998
Keefe*	0.6	1	67	1926	CA	Miscellaneous	3,269,997
Sturges (Gila Monster Farms, Inc.)	436	780	16	1925	AZ	Miscellaneous	3,269,996
Chagnon	72	120	41	1925	CA	Miscellaneous	3,269,560
Faubion*	0.6	1	48	1925	CA	Miscellaneous	3,269,488
Earle*	0.6	1	58	1925	CA	Miscellaneous	3,269,487
Whittle*	0.6	1	78	1925	CA	Miscellaneous	3,269,487
Beauchamp*	0.6	1	51	1924	CA	Miscellaneous	3,269,486
McGee*	0.6	1	63	1924	CA	Miscellaneous	3,269,486
Stallard*	0.6	1	64	1924	CA	Miscellaneous	3,269,485
Hadlock*	0.6	1	72	1924	CA	Miscellaneous	3,269,484
Stephenson	137	240	30	1923	CA	Miscellaneous	3,269,484
Draper, G.*	0.6	1	46	1923	CA	Miscellaneous	3,269,347
Dudley*	0.6	1	49	1922	CA	Miscellaneous	3,269,346
Colorado River Sportsmen's League	58	96	36	1921	CA	Miscellaneous	3,269,346
Andrade	37	66	38	1921	CA	Miscellaneous	3,269,288
Conger*	0.6	1	45	1921	CA	Miscellaneous	3,269,251
Vaulin*	0.6	1	70	1920	CA	Miscellaneous	3,269,251
Salisbury*	0.6	1	71	1920	CA	Miscellaneous	3,269,250
McDonough*	0.6	1	47	1919	CA	Miscellaneous	3,269,249
Cate*	0.6	1	62	1919	CA	Miscellaneous	3,269,249
Milpitas	65	108	34	1918	CA	Miscellaneous	3,269,248
Yuma Auxiliary Project, Unit B	4,176	6,800	5	1905	AZ	Federal Establishments & Water Projects*	3,269,183
North Gila Valley Unit, Yuma Mesa Division, Gila Project	4,959	24,500	6	1905	AZ	Federal Establishments & Water Projects*	3,265,007

Entitlement Holders	CU Equivalent (AF)†	Diversion (AF)	PPR No.	Date	State	Category	Cumulative Consumptive Use Equivalent (AF)
Reservation Division/Yuma Project (non-Indian portion)	18,599	38,270	28	1905	CA	Federal Establishments & Water Projects*	3,260,049
Valley Division, Yuma Project (Yuma County Water Users' Association)	180,834	254,200	4	1901	AZ	Federal Establishments & Water Projects*	3,241,450
Imperial Irrigation District & CVWD lands	2,485,000	2,600,000	27	1901	CA	Federal Establishments & Water Projects*	3,060,615
Palo Verde Irrigation District	100,231	219,780	26	1877	CA	Federal Establishments & Water Projects*	575,615
Cocopah Indian Reservation	4,941	7,681	1	1917	AZ	Indian Reservations	475,384
Schneider*	0.6	1	56	1917	CA	Miscellaneous	470,443
Douglas*	0.6	1	50	1916	CA	Miscellaneous	470,442
Clark*	0.6	1	52	1916	CA	Miscellaneous	470,442
Graham*	0.6	1	61	1916	CA	Miscellaneous	470,441
Powers	624	960	7	1915	AZ	Miscellaneous	470,441
United States (Cocopah Indian Tribe)	733	1,140	8	1915	AZ	Miscellaneous	469,817
Lawrence	72	120	42	1915	CA	Miscellaneous	469,083
Lawrence*	0.6	1	53	1915	CA	Miscellaneous	469,011
Milpitas	41	69	37	1914	CA	Miscellaneous	469,011
Graham, J.*	0.6	1	54	1914	CA	Miscellaneous	468,969
Morgan	90	150	33	1913	CA	Miscellaneous	468,969
Zozaya (MVIDD)	389	720	17	1912	AZ	Miscellaneous	468,879
Reid*	0.6	1	60	1912	CA	Miscellaneous	468,490
Fitz*	0.6	1	75	1912	CA	Miscellaneous	468,489
EPCOR CSA #2 (Formerly Brooke Water Company) (Graham)	241	360	9	1910	AZ	Miscellaneous	468,489
Geiger*	0.6	1	55	1910	CA	Miscellaneous	468,248
Williams*	0.6	1	76	1909	CA	Miscellaneous	468,247
Chemehuevi Indian Reservation	6,091	11,340	22	1907	CA	Indian Reservations	468,246
Parker, City of	400	630	20	1905	AZ	Miscellaneous	462,155
Cooper	36	60	40	1905	CA	Miscellaneous	461,755
Reynolds	22	36	39	1904	CA	Miscellaneous	461,719
Ferguson, C.*	0.6	1	68	1903	CA	Miscellaneous	461,698
Ferguson, W.*	0.6	1	69	1903	CA	Miscellaneous	461,697
Streeter*	0.6	1	73	1903	CA	Miscellaneous	461,696
Draper, J.*	0.6	1	74	1903	CA	Miscellaneous	461,696
Hulet (MVIDD)	648	1,080	10	1902	AZ	Miscellaneous	461,695
Hurschler (First American Title Insurance Agency of Mohave, Inc.) (MVIDD)	567	1,050	11	1902	AZ	Miscellaneous	461,047
Miller (MVIDD)	130	240	12	1902	AZ	Miscellaneous	460,480
McKellips and Granite Reef Farms (MVIDD)	437	810	13	1902	AZ	Miscellaneous	460,351
Sherrill & Lafollette (MVIDD)	583	1,080	14	1902	AZ	Miscellaneous	459,913
Swan (MVIDD)	518	960	18	1902	AZ	Miscellaneous	459,330
Phillips, Milton and Jean	25	42	19	1900	AZ	Miscellaneous	458,812
Atchison, Topeka, and Santa Fe Railway Co.	273	1,260	44	1896	CA	Miscellaneous	458,786
Martinez*	0.6	1	57	1895	CA	Miscellaneous	458,513
Yuma, City of	1,478	2,333	21	1893	AZ	Miscellaneous	458,513
Mendivil (Picacho Development Corp. and CA Dept. of Parks and Rec.)	72	120	31	1893	CA	Miscellaneous	457,035
Fort Mojave Indian Reservation	40,806	75,566	3	1890	AZ	Indian Reservations	456,963
Fort Mojave Indian Reservation	15,103	27,969	3	1890	AZ	Indian Reservations	416,157

Entitlement Holders	CU Equivalent (AF)†	Diversion (AF)	PPR No.	Date	State	Category	Cumulative Consumptive Use Equivalent (AF)
Fort Mojave Indian Reservation	8,995	16,720	25	1890	CA	Indian Reservations	401,054
Fort Mojave Indian Reservation	8,397	12,534	81	1890	NV	Indian Reservations	392,059
Simons	36	60	35	1889	CA	Miscellaneous	383,662
City of Needles	950	1,500	43	1885	CA	Miscellaneous	383,626
Fort Yuma Indian Reservation	39,594	71,616	23	1884	CA	Indian Reservations	382,676
Fort Yuma Indian Reservation	4,039	6,350	3a	1884	AZ	Indian Reservations	343,081
Colorado River Indian Reservation	3,417	5,860	24	1876	CA	Indian Reservations	339,043
Colorado River Indian Reservation	23,966	51,986	2	1874	AZ	Indian Reservations	335,626
Colorado River Indian Reservation	23,463	40,241	24	1874	CA	Indian Reservations	311,660
Colorado River Indian Reservation	116,179	252,016	2	1873	AZ	Indian Reservations	288,198
Colorado River Indian Reservation	6,265	10,745	24	1873	CA	Indian Reservations	172,018
Colorado River Indian Reservation	165,222	358,400	2	1865	AZ	Indian Reservations	165,753
Yuma Associates LTD and Winterhaven Water District (formerly Wavers)	531	780	29	1856	CA	Miscellaneous	531
Total	**3,270,473**	**4,110,578**	-	-	-	-	-

†Calculated consumptive use equivalents in italics (factor of .6 were given by the Court; for IID/CVWD, 115,000af of return flow; all others according to their CU/diversion ratio from Reclamation's *Colorado River Accounting and Water Use Report: Arizona, California, and Nevada*). The Cumulative Consumptive Use Equivalent column is included as a reference for the estimated amount of water that would need to be available to PPRs to fulfill a given entitlement on this table.

*Fill order reflects paragraph (5) of the Appendix to the 2006 Consolidated Decree in Arizona v. California: "In the event of a determination of insufficient mainstream water to satisfy present perfected rights pursuant to Article II(B)(3) of this decree, the Secretary of the Interior shall, before providing for the satisfaction of any of the other present perfected rights except for those listed herein as "MISCELLANEOUS PRESENT PERFECTED RIGHTS" (rights numbered 7–21 and 29–80 below) in the order of their priority dates without regard to state lines, first provide for the satisfaction in full of all rights of the Chemehuevi Indian Reservation, Cocopah Indian Reservation, Fort Yuma Indian Reservation, Colorado River Indian Reservation, and the Fort Mojave Indian Reservation as set forth in Article II(D)(1)–(5) of this decree...".

E.3.4 Shortage Allocation Model Results

The tables in this section summarize the results of the Shortage Allocation Model over the range of total shortages to the Lower Division States that comprise the 2007 Interim Guidelines shortage reductions and 2019 DCP water savings contributions.

Table E-12 below summarizes the shortage attributed to each priority within the Lower Division States in the Shortage Allocation Model. Contracts for Arizona fifth and sixth priority and unused water within CAP, and CAP excess contracts, are immediately affected and potentially fully reduced. The only other priority group potentially fully reduced in the Shortage Allocation Model is CAP NIA Priority, although other priorities are affected to some degree.

Table E-12
Shortage Allocation Model Regional Summary

Summary of Shortage Impacts by State and Priority		Range of Analyzed Volumes of Total Shortage to Lower Division States (AF)							
-	-	**200,000**	**533,000**	**617,000**	**867,000**	**917,000**	**967,000**	**1,017,000**	**1,100,000**
Arizona	**Priority**	-	-	-	-	-	-	-	-
	5th, 6th, and CAP Agricultural and Other Excess	192,000	294,465	335,708	338,687	338,687	338,687	338,687	330,681
	4th Priority i (Mainstream)	0	0	0	0	0	0	0	18,520
	4th Priority ii (CAP)[1]	-	-	-	-	-	-	-	-
	NIA Priority	0	217,535	245,633	245,633	245,633	245,633	245,633	245,633
	M&I Priority	0	0	0	32,302	32,302	32,302	32,302	80,877
	Indian Priority	0	0	10,659	23,378	23,378	23,378	23,378	44,289
	2nd & 3rd Priorities	0	0	0	0	0	0	0	0
	1st Priority (Present Perfected Rights)	0	0	0	0	0	0	0	0
	Subtotal	**192,000**	**512,000**	**592,000**	**640,000**	**640,000**	**640,000**	**640,000**	**720,000**
California	**Priority**	-	-	-	-	-	-	-	-
	4th Priority (MWD)	0	0	0	186,000	232,500	279,000	325,500	325,500
	3rd Priority (IID, CVWD, PVID, QSA Diversions by MWD)	0	0	0	14,000	17,500	21,000	24,500	24,500
	2nd Priority (Yuma Project Reservation Division)	0	0	0	0	0	0	0	0
	1st Priority (PVID)	0	0	0	0	0	0	0	0
	Present Perfected Rights (PPRs)	0	0	0	0	0	0	0	0
	Subtotal	**0**	**0**	**0**	**200,000**	**250,000**	**300,000**	**350,000**	**350,000**

Summary of Shortage Impacts by State and Priority		Range of Analyzed Volumes of Total Shortage to Lower Division States (AF)							
Nevada	**Priority**	-	-	-	-	-	-	-	-
	8th Priority (SNWA - Balance & Unused)	8,000	21,000	25,000	27,000	27,000	27,000	27,000	30,000
	8th Priority (SNWA & Big Bend)	0	0	0	0	0	0	0	0
	7th Priority (Boy Scouts, Reclamation, NV Dept. of Wildlife)	0	0	0	0	0	0	0	0
	6th Priority (Las Vegas Valley Water District)	0	0	0	0	0	0	0	0
	5th Priority (PABCO & Lakeview Co.)	0	0	0	0	0	0	0	0
	4th Priority (Henderson & Basic Management)	0	0	0	0	0	0	0	0
	3rd Priority (Boulder City)	0	0	0	0	0	0	0	0
	2nd Priority (Lake Mead National Rec. Area)	0	0	0	0	0	0	0	0
	1st Priority (PPRs: LMNRA & Fort Mojave Indian Reservation)	0	0	0	0	0	0	0	0
	Subtotal	**8,000**	**21,000**	**25,000**	**27,000**	**27,000**	**27,000**	**27,000**	**30,000**
-	**Total**	**200,000**	**533,000**	**617,000**	**867,000**	**917,000**	**967,000**	**1,017,000**	**1,100,000**

Note: This analysis does not reflect an operational estimate of when water may cease to be physically available to certain users.
Note: Orange highlights indicate the level at which available water for a priority is reduced to zero.
[1]Agricultural and other CAP excess contracts do not confer a Colorado River water entitlement and are assumed to be unavailable for the purpose of this analysis.
Disclaimer: These modeling results should only be used to compare the relative magnitude of effects reasonably expected to occur under the alternatives evaluated in this SEIS. Modeling assumptions should not be taken as agency position with respect to contract or statutory interpretation, and they are not intended to limit Secretarial discretion with respect to current or future policy. This model is not a substitute for the annual process of reviewing water orders and determining which can be filled, and it cannot replicate the precision required for that process.

Table E-13 below summarizes the shortage impacts on Tribes according to the Shortage Allocation Model. Tribal entitlements within the Arizona fourth priority are potentially affected, and CAP NIA Priority entitlements are potentially fully reduced.

Table E-13
Shortage Allocation Model Tribal Summary

Summary of Consumptive Use Impacts on Tribal Allocations			Range of Analyzed Volumes of Total Shortage to Lower Division States (AF)							
Arizona			200,000	533,000	617,000	867,000	917,000	967,000	1,017,000	1,100,000
Priority	**Entitlement Holder**	**County**	-	-	-	-	-	-	-	-
4(i)	Hopi Tribe[1]	La Paz County	0	0	0	0	0	0	0	1,164
4(i)	Cocopah Indian Reservation[2]	Yuma County	0	0	0	0	0	0	0	0
CAP Indian Priority	Gila River Indian Community[1]	Maricopa and Pinal Counties	0	0	10,659	23,378	23,378	23,378	23,378	39,517
CAP Indian Priority	Tohono O'odham Nation (Schuk Toak & San Xavier Districts)[1]	Pima County	0	0	0	0	0	0	0	0
CAP Indian Priority	White Mountain Apache Tribe	Apache, Gila, and Navajo Counties	0	0	0	0	0	0	0	0
CAP Indian Priority	Ak-Chin Indian Community[1]	Pinal County	0	0	0	0	0	0	0	3,744
CAP Indian Priority	Fort McDowell Yavapai Nation	Maricopa County	0	0	0	0	0	0	0	0
CAP Indian Priority	Pascua Yaqui Tribe	Pima County	0	0	0	0	0	0	0	0
CAP Indian Priority	San Carlos Apache Tribe	Gila County	0	0	0	0	0	0	0	173
CAP Indian Priority	Salt River Pima-Maricopa Indian Community	Maricopa County	0	0	0	0	0	0	0	854
CAP Indian Priority	Tohono O'odham Nation Sif Oidak District	Pinal County	0	0	0	0	0	0	0	0
CAP Indian Priority	Tonto Apache Tribe	Gila County	0	0	0	0	0	0	0	0
CAP Indian Priority	Yavapai Apache Nation	Gila County	0	0	0	0	0	0	0	0
CAP M&I Priority	San Carlos Apache Tribe	Gila County	0	0	0	973	973	973	973	2,435
CAP NIA-A Priority	Tohono O'odham Nation (Schuk Toak & San Xavier Districts)	Pima County	0	24,260	28,200	28,200	28,200	28,200	28,200	28,200
CAP NIA-A Priority	Gila River Indian Community	Maricopa and Pinal County	0	103,750	120,600	120,600	120,600	120,600	120,600	120,600
CAP NIA-B Priority	White Mountain Apache Tribe	Apache, Gila, and Navajo Counties	0	0	0	0	0	0	0	0
3	Ak-Chin Indian Community[1]	Pinal County	0	0	0	0	0	0	0	0

Summary of Consumptive Use Impacts on Tribal Allocations			Range of Analyzed Volumes of Total Shortage to Lower Division States (AF)							
Arizona			**200,000**	**533,000**	**617,000**	**867,000**	**917,000**	**967,000**	**1,017,000**	**1,100,000**
Priority	**Entitlement Holder**	**County**	-	-	-	-	-	-	-	-
1 (PPR)	Cocopah Indian Reservation[1]	Yuma County	0	0	0	0	0	0	0	0
1 (PPR)	United States (Cocopah Indian Tribe)[1]	Yuma County	0	0	0	0	0	0	0	0
1 (PPR)	Fort Mojave Indian Reservation[1]	Mohave County	0	0	0	0	0	0	0	0
1 (PPR)	Fort Yuma Indian Reservation[1]	Yuma County	0	0	0	0	0	0	0	0
1 (PPR)	Colorado River Indian Reservation[1]	La Paz County	0	0	0	0	0	0	0	0
-	-	**Subtotal**	**0**	**128,010**	**159,459**	**173,151**	**173,151**	**173,151**	**173,151**	**196,688**
California			-	-	-	-	-	-	-	-
Priority	**Entitlement Holder**	**County**	-	-	-	-	-	-	-	-
PPR	Chemehuevi Indian Reservation[1]	San Bernardino	0	0	0	0	0	0	0	0
PPR	Fort Mojave Indian Reservation[1]	San Bernardino	0	0	0	0	0	0	0	0
PPR	Fort Yuma Indian Reservation[1]	Imperial	0	0	0	0	0	0	0	0
PPR	Colorado River Indian Reservation[1]	San Bernardino, Riverside	0	0	0	0	0	0	0	0
-	-	**Subtotal**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Nevada			-	-	-	-	-	-	-	-
Priority	**Entitlement Holder**	**County**	-	-	-	-	-	-	-	-
1 (PPR)	Fort Mojave Indian Reservation[1]	Clark	0	0	0	0	0	0	0	0
-	-	**Subtotal**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
-	-	**Total**	**0**	**128,010**	**159,459**	**173,151**	**173,151**	**173,151**	**173,151**	**196,688**
Summary by County			-	-	-	-	-	-	-	-
-	**Arizona**	**# of Entitlement Holders /County**	-	-	-	-	-	-	-	-
-	Coconino County	0	0	0	0	0	0	0	0	0
-	Gila County	4.33	0	0	0	973	973	973	973	2,609
-	La Paz County	2	0	0	0	0	0	0	0	1,164
-	Maricopa County	2.3	0	31,125	39,378	43,193	43,193	43,193	43,193	48,889
-	Mohave County	1	0	0	0	0	0	0	0	0
-	Pima County	3	0	24,260	28,200	28,200	28,200	28,200	28,200	28,200

Summary by County			-	-	-	-	-	-	-	-
-	**Arizona**	**# of Entitlement Holders /County**	-	-	-	-	-	-	-	-
-	Pinal County	3.70	0	72,625	91,881	100,785	100,785	100,785	100,785	115,826
-	Yuma County	4	0	0	0	0	0	0	0	0
-	Apache County	0.33	0	0	0	0	0	0	0	0
-	Navajo County	0.33	0	0	0	0	0	0	0	0
-	**Subtotal Arizona Tribal**	**21**	**0**	**128,010**	**159,459**	**173,151**	**173,151**	**173,151**	**173,151**	**196,688**
-	**California**	-	-	-	-	-	-	-	-	-
-	San Bernardino	2.5	0	0	0	0	0	0	0	0
-	Riverside	0.50	0	0	0	0	0	0	0	0
-	Imperial	1	0	0	0	0	0	0	0	0
-	**Subtotal California Tribal**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
-	**Nevada**	-	-	-	-	-	-	-	-	-
-	Clark	1	0	0	0	0	0	0	0	0
-	**Subtotal Nevada Tribal**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Note: PPRs are included here to provide a complete list of tribal entitlements, but they are not affected at the evaluated levels of shortage.
Note: Orange highlights indicate the level at which available water for a user under this priority is reduced to zero.
Note: This preliminary analysis attributes shortage to the base allocation or entitlement according to its priority. The ultimate impacts, both financial and in terms of the lost productive value of water, are diverse according to their varied uses and compensation structures under a large body of exchanges, leases, and other federal and non-federal arrangements and commitments. This distribution of shortage to the base allocation only provides the initial necessary information to assess impacts in detail as part of administering the related contracts; actual water orders received each year will affect those impacts.
Note: This analysis does not reflect an operational estimate of when water may cease to be physically available to certain users.
[1]Denotes full or substantial use in Tribal agricultural operations, which may or may not be affected according to the terms of related agreements.
[2]This user also holds a PPR entitlement, which is not affected at these levels of shortages.

Table E-14 below summarizes the shortage impacts on irrigation according to the Shortage Allocation Model. Contracts for Arizona fifth and sixth priority and unused[14] water within CAP, and CAP excess contracts, are immediately affected and potentially fully reduced, but other irrigation entitlements are potentially affected at the deepest levels of shortage.

Table E-14
Shortage Allocation Model Irrigation Summary

Summary of Consumptive Use Impacts on Irrigation			Range of Analyzed Volumes of Total Shortage to Lower Division States (AF)							
Arizona			200,000	533,000	617,000	867,000	917,000	967,000	1,017,000	1,100,000
Priority	**Entitlement Holder**	**County**	-	-	-	-	-	-	-	-
All Other	5th and 6th Priority Contracts, and CAP Agricultural and Other Excess	Maricopa, Pinal, and Pima Counties	192,000	294,465	335,708	338,687	338,687	338,687	338,687	330,681
4(i)	Arizona Game and Fish Commission	La Paz County	0	0	0	0	0	0	0	772
4(i)	Arizona State Land Department	Yuma County	0	0	0	0	0	0	0	1,545
4(i)	Beattie Farms, Southwest	Yuma County	0	0	0	0	0	0	0	138
4(i)	Bishop, Alfred F. and Erma Jean Family Trust	La Paz County	0	0	0	0	0	0	0	0
4(i)	Cathcart, Bruce Y. and Lora M. and James Y. and Maria E.	La Paz County	0	0	0	0	0	0	0	7
4(i)	ChaCha, LLC	Yuma County	0	0	0	0	0	0	0	31
4(i)	Cibola Sportsman's Club, Inc.	La Paz County	0	0	0	0	0	0	0	43
4(i)	Cibola Valley Irrigation and Drainage District[2]	La Paz County	0	0	0	0	0	0	0	2,027
4(i)	Curtis, Armon	Yuma County	0	0	0	0	0	0	0	41
4(i)	Gila Monster Farms, Inc.[3]	Yuma County	0	0	0	0	0	0	0	0
4(i)	GM Gabrych Family Limited Partnership	La Paz County	0	0	0	0	0	0	0	1,087
4(i)	GSC Farm, LLC	La Paz County	0	0	0	0	0	0	0	19
4(i)	JRJ Partners, L.L.C.	Yuma County	0	0	0	0	0	0	0	227
4(i)	Mohave Valley Irrigation and Drainage District[2,3]	Mohave County	0	0	0	0	0	0	0	6,992
4(i)	North Baja Pipeline, LLC[2]	La Paz County	0	0	0	0	0	0	0	4
4(i)	Ogram Boys Enterprises, Inc.	Yuma County	0	0	0	0	0	0	0	221

[14] Under Article 3.(b) of the 1985 Contract Between the United States and the Ak-Chin Indian Community to Provide Permanent Water and Settle Interim Water Rights, in any year in which sufficient surface water is available, the Secretary shall deliver certain additional water to the Ak-Chin Indian Community. Such water is assumed to be available if there is unused CAP water, after CAP orders under long-term contracts and subcontracts are fulfilled; it is not itemized, but there is only unused water projected to be available at the 200,000 af level of total shortage in the Shortage Allocation Model.

Summary of Consumptive Use Impacts on Irrigation			Range of Analyzed Volumes of Total Shortage to Lower Division States (AF)							
Arizona			**200,000**	**533,000**	**617,000**	**867,000**	**917,000**	**967,000**	**1,017,000**	**1,100,000**
Priority	**Entitlement Holder**	**County**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
4(i)	Ott, Larry and Gina, and Lee C. and Candace M.	Yuma County	0	0	0	0	0	0	0	33
4(i)	Pasquinelli, Gary J. and Barbara J.	Yuma County	0	0	0	0	0	0	0	0
4(i)	Red River Land Company, LLC	La Paz County	0	0	0	0	0	0	0	80
4(i)	Western Water, LLC	La Paz County	0	0	0	0	0	0	0	0
3	Sturges, Harold	Yuma County	0	0	0	0	0	0	0	0
3	Sturges, Irma	Yuma County	0	0	0	0	0	0	0	0
3	Yuma Mesa Irrigation & Drainage District (10,000af M&I)[1]	Yuma County	0	0	0	0	0	0	0	0
3	Yuma Irrigation District (5,000af M&I)[1]	Yuma County	0	0	0	0	0	0	0	0
3	North Gila Valley Irrigation District (2,500af M&I)[1,3]	Yuma County	0	0	0	0	0	0	0	0
3	Wellton-Mohawk Irrigation and Drainage District (12,000af M&I)[1]	Yuma County	0	0	0	0	0	0	0	0
3	Gila Monster Farms (formerly Sturges)[3]	Yuma County	0	0	0	0	0	0	0	0
3	Yuma County Water Users' Association (14,701af M&I includes YAO's 489.95af conversion)[2,3]	Yuma County	0	0	0	0	0	0	0	0
3	University of Arizona	Yuma County	0	0	0	0	0	0	0	0
3	Camille Allec, Jr. (Formerly Yuma Mesa Grapefruit Company)	Yuma County	0	0	0	0	0	0	0	0
3	Unit B Irrigation & Drainage District[3]	Yuma County	0	0	0	0	0	0	0	0
-	-	**Subtotal**	**192,000**	**294,465**	**335,708**	**338,687**	**338,687**	**338,687**	**338,687**	**343,948**
California			-	-	-	-	-	-	-	-
3	Palo Verde Irrigation District (3b) - Lower Palo Verde Mesa Lands	Riverside County	0	0	0	0	0	0	0	0
3	Coachella Valley Water District (CVWD) (3a)	Riverside County	0	0	0	14,000	17,500	21,000	24,500	24,500
3	Imperial Irrigation District (IID) (3a)	Imperial County	0	0	0	0	0	0	0	0
2	Yuma Project, Reservation Division4 (Bard Unit Only - Indian Unit Under PPRs)	Imperial County	0	0	0	0	0	0	0	0
1	Palo Verde Irrigation District - Valley Lands	Riverside, Imperial	0	0	0	0	0	0	0	0
-	-	**Subtotal**	**0**	**0**	**0**	**14,000**	**17,500**	**21,000**	**24,500**	**24,500**

Nevada			-	-	-	-	-	-	-	-
None	None		0	0	0	0	0	0	0	0
-	-	**Subtotal**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
-	-	**Total**	**192,000**	**294,465**	**335,708**	**352,687**	**356,187**	**359,687**	**363,187**	**368,448**

Summary by County			**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
-	**Arizona**	**# of Entitlement Holders /County**	-	-	-	-	-	-	-	-
-	Coconino County	0	0	0	0	0	0	0	0	0
-	La Paz County	10	0	0	0	0	0	0	0	4,040
-	Mohave County	1	0	0	0	0	0	0	0	6,992
-	Yuma County	20	0	0	0	0	0	0	0	2,236
-	Pima County	0.2	38,400	58,893	67,142	67,737	67,737	67,737	67,737	66,136
-	Pinal County	0.5	96,000	147,233	167,854	169,344	169,344	169,344	169,344	165,340
-	Maricopa County	0.3	57,600	88,340	100,712	101,606	101,606	101,606	101,606	99,204
-	Subtotal Arizona Irrigation	31	192,000	294,465	335,708	338,687	338,687	338,687	338,687	343,948
-	**California**	-	-	-	-	-	-	-	-	-
-	Riverside County	2.5	0	0	0	14,000	17,500	21,000	24,500	24,500
-	Imperial County	2.5	0	0	0	0	0	0	0	0
-	Subtotal California Irrigation	5	0	0	0	14,000	17,500	21,000	24,500	24,500
-	**Nevada**	-	-	-	-	-	-	-	-	-
-	None	None	0	0	0	0	0	0	0	0

[1]Combined irrigation and domestic entitlement where domestic use is contractually subordinated to irrigation.
[2]Combined irrigation and domestic entitlement where priority of domestic and irrigation uses may be subject to an annual determination that varies based on the water supply conditions.
[3]This user also holds a PPR entitlement, which is not affected at these levels of shortages, and it was not included here.
Note: PPR entitlements are not affected at these levels of shortage.
Note: Orange highlights indicate the level at which available water for a user under this priority is reduced to zero.
Note: This analysis does not reflect an operational estimate of when water may cease to be physically available to certain users.
Disclaimer: These modeling results from the Shortage Allocation Model should only be used to compare the relative magnitude of effects reasonably expected to occur under the alternatives evaluated in this SEIS. Modeling assumptions should not be taken as agency position with respect to contract or statutory interpretation, and they are not intended to limit Secretarial discretion with respect to current or future policy. This model is not a substitute for the annual process of reviewing water orders and determining which can be filled, and it cannot replicate the precision required for that process.

Table E-15 below summarizes the shortage impacts on domestic use according to the Shortage Allocation Model. Within the Arizona P4(i), certain domestic users may be affected at the deepest level of modeled shortage. CAP M&I Priority uses are potentially affected, and CAP NIA Priority uses are potentially fully reduced. Domestic impacts within California and Nevada are limited to MWD and SNWA, respectively.

Table E-15
Shortage Allocation Model Domestic Summary

Summary of Consumptive Use Impacts on Domestic Uses			Range of Analyzed Volumes of Total Shortage to Lower Division States (AF)							
Arizona			200,000	533,000	617,000	867,000	917,000	967,000	1,017,000	1,100,000
Priority	Entitlement Holder	County	-	-	-	-	-	-	-	-
4(i)	Arizona State Land Department	Yuma County	0	0	0	0	0	0	0	0
4(i)	Arizona State Parks Board - Windsor Beach	Mohave County	0	0	0	0	0	0	0	0
4(i)	B&F Investment, LLC	La Paz County	0	0	0	0	0	0	0	0
4(i)	Bullhead City	Mohave County	0	0	0	0	0	0	0	2,337
4(i)	Bullhead City (Mohave County Water Authority (MCWA) Subcontract)	Mohave County	0	0	0	0	0	0	0	0
4(i)	Bullhead City (MCWA Subcontract)	Mohave County	0	0	0	0	0	0	0	0
4(i)	Bureau of Land Management (diversion estimated)	La Paz County	0	0	0	0	0	0	0	0
4(i)	Crystal Beach Water Conservation District	Mohave County	0	0	0	0	0	0	0	20
4(i)	Desert Lawn Memorial Park Association, Inc.	Yuma County	0	0	0	0	0	0	0	0
4(i)	Ehrenburg Improvement District	La Paz County	0	0	0	0	0	0	0	0
4(i)	EPCOR Water Arizona Inc.[1]	Mohave County	0	0	0	0	0	0	0	0
4(i)	Fisher's Landing Water and Sewer Works, L.L.C.	Yuma County	0	0	0	0	0	0	0	0
4(i)	Frontier Communications West Coast Inc.	La Paz County	0	0	0	0	0	0	0	1
4(i)	Gold Dome Mining Corporation	Yuma County	0	0	0	0	0	0	0	0
4(i)	Gold Standard Mines Corp.	Mohave County	0	0	0	0	0	0	0	0
4(i)	Golden Shores Water Conservation District	Mohave County	0	0	0	0	0	0	0	0
4(i)	Hillcrest Water Company	La Paz County	0	0	0	0	0	0	0	0
4(i)	Lake Havasu City	Mohave County	0	0	0	0	0	0	0	638
4(i)	Lake Havasu City (MCWA Subcontract)	Mohave County	0	0	0	0	0	0	0	0

Summary of Consumptive Use Impacts on Domestic Uses			Range of Analyzed Volumes of Total Shortage to Lower Division States (AF)							
Arizona			200,000	533,000	617,000	867,000	917,000	967,000	1,017,000	1,100,000
Priority	Entitlement Holder	County	-	-	-	-	-	-	-	-
4(i)	Lake Havasu City (MCWA Subcontract)	Mohave County	0	0	0	0	0	0	0	0
4(i)	La Paz County	La Paz County	0	0	0	0	0	0	0	0
4(i)	McAlister Family Trust	Mohave County	0	0	0	0	0	0	0	0
4(i)	Mohave Valley Irrigation and Drainage District (MCWA Subcontract)	Mohave County	0	0	0	0	0	0	0	257
4(i)	Mohave Water Conservation District	Mohave County	0	0	0	0	0	0	0	62
4(i)	Mohave Water Conservation District (MCWA Subcontract)	Mohave County	0	0	0	0	0	0	0	0
4(i)	Parker, Town of[1]	La Paz County	0	0	0	0	0	0	0	0
4(i)	Quartzsite, Town of	La Paz County	0	0	0	0	0	0	0	0
4(i)	Queen Creek, Town of	Maricopa County	0	0	0	0	0	0	0	774
4(i)	Roy, Estates of Anna R. and Edward P.	Yuma County	0	0	0	0	0	0	0	0
4(i)	Shepard Water Company, Incorporated	Yuma County	0	0	0	0	0	0	0	0
4(i)	Somerton, City of	Yuma County	0	0	0	0	0	0	0	0
4(i)	Springs Del Sol Domestic Water Improvement District	La Paz County	0	0	0	0	0	0	0	0
4(i)	TV Marble Canyon AZ, LLC	Coconino County	0	0	0	0	0	0	0	0
CAP Indian	Scottsdale (Yavapai Prescott Indian Tribe Allocation)	Maricopa County	0	0	0	0	0	0	0	0
CAP M&I	ASARCO	Pima County	0	0	0	1,126	1,126	1,126	1,126	2,818
CAP M&I	Avondale	Maricopa County	0	0	0	290	290	290	290	727
CAP M&I	Arizona State Land Department (AZSLD)	Maricopa County	0	0	0	279	279	279	279	698
CAP M&I	Arizona Water Company, Casa Grande	Pinal County	0	0	0	476	476	476	476	1,192
CAP M&I	Arizona Water Company, Coolidge	Pinal County	0	0	0	107	107	107	107	268
CAP M&I	Arizona Water Company, Superstition	Pinal County	0	0	0	337	337	337	337	844
CAP M&I	Arizona Water Company, White Tank	Maricopa County	0	0	0	52	52	52	52	130
CAP M&I	Buckeye	Maricopa County	0	0	0	12	12	12	12	30
CAP M&I	Central Arizona Groundwater Replenishment District (CAGRD)	Maricopa County	0	0	0	344	344	344	344	862
CAP M&I	Carefree Water Company	Maricopa County	0	0	0	47	47	47	47	119
CAP M&I	Cave Creek	Maricopa County	0	0	0	140	140	140	140	350
CAP M&I	Chandler	Maricopa County	0	0	0	464	464	464	464	1,161
CAP M&I	Chaparral City Water Company	Maricopa County	0	0	0	478	478	478	478	1,196

Summary of Consumptive Use Impacts on Domestic Uses			Range of Analyzed Volumes of Total Shortage to Lower Division States (AF)							
Arizona			200,000	533,000	617,000	867,000	917,000	967,000	1,017,000	1,100,000
Priority	Entitlement Holder	County	-	-	-	-	-	-	-	-
CAP M&I	Circle City	Maricopa County	0	0	0	0	0	0	0	0
CAP M&I	El Mirage	Maricopa County	0	0	0	27	27	27	27	68
CAP M&I	Eloy	Pinal County	0	0	0	116	116	116	116	291
CAP M&I	EPCOR, Agua Fria	Maricopa County	0	0	0	595	595	595	595	1,489
CAP M&I	EPCOR, Paradise Valley	Maricopa County	0	0	0	173	173	173	173	434
CAP M&I	EPCOR, Sun City	Maricopa County	0	0	0	225	225	225	225	562
CAP M&I	EPCOR, Sun City West	Maricopa County	0	0	0	127	127	127	127	318
CAP M&I	Florence	Pinal County	0	0	0	110	110	110	110	275
CAP M&I	Freeport-Miami	Gila County	0	0	0	156	156	156	156	390
CAP M&I	Flowing Wells Irrigation District (FWID)	Pima County	0	0	0	153	153	153	153	383
CAP M&I	Gilbert	Maricopa County	0	0	0	388	388	388	388	971
CAP M&I	Glendale	Maricopa County	0	0	0	924	924	924	924	2,313
CAP M&I	Goodyear	Maricopa County	0	0	0	576	576	576	576	1,442
CAP M&I	Greater Tonopah, Water Utility	Maricopa County	0	0	0	3	3	3	3	9
CAP M&I	Green Valley Community Water Company	Pima County	0	0	0	0	0	0	0	0
CAP M&I	Green Valley Domestic Water Improvement District	Pima County	0	0	0	0	0	0	0	0
CAP M&I	Marana	Pima County	0	0	0	125	125	125	125	314
CAP M&I	Maricopa County Parks & Recreation	Maricopa County	0	0	0	36	36	36	36	89
CAP M&I	Mesa	Maricopa County	0	0	0	2,332	2,332	2,332	2,332	5,839
CAP M&I	Metropolitan Domestic Water Improvement District (Includes ICS Creation)	Pima County	0	0	0	722	722	722	722	1,807
CAP M&I	Oro Valley	Pima County	0	0	0	552	552	552	552	1,383
CAP M&I	Peoria	Maricopa County	0	0	0	1,454	1,454	1,454	1,454	3,640
CAP M&I	Phoenix	Maricopa County	0	0	0	6,551	6,551	6,551	6,551	16,401
CAP M&I	Pine	Gila County	0	0	0	0	0	0	0	0
CAP M&I	Queen Creek	Maricopa County	0	0	0	27	27	27	27	66
CAP M&I	Rio Verde Utilities	Maricopa County	0	0	0	44	44	44	44	109
CAP M&I	San Tan Irrigation District	Maricopa County	0	0	0	0	0	0	0	0
CAP M&I	Scottsdale	Maricopa County	0	0	0	2,831	2,831	2,831	2,831	7,088
CAP M&I	Spanish Trail Water Company	Pima County	0	0	0	163	163	163	163	408
CAP M&I	Surprise	Maricopa County	0	0	0	549	549	549	549	1,376
CAP M&I	Tempe	Maricopa County	0	0	0	231	231	231	231	579
CAP M&I	Tonopah	Maricopa County	0	0	0	0	0	0	0	0

Summary of Consumptive Use Impacts on Domestic Uses			Range of Analyzed Volumes of Total Shortage to Lower Division States (AF)							
Arizona			200,000	533,000	617,000	867,000	917,000	967,000	1,017,000	1,100,000
Priority	Entitlement Holder	County	-	-	-	-	-	-	-	-
CAP M&I	Tonto Hills Domestic Water Improvement District	Maricopa County	0	0	0	4	4	4	4	10
CAP M&I	Tucson	Pima County	0	0	0	7,729	7,729	7,729	7,729	19,352
CAP M&I	Vail Water Company	Pima County	0	0	0	100	100	100	100	249
CAP M&I	Water Utilities Community Facilities District, Apache Junction	Pinal County	0	0	0	156	156	156	156	392
CAP NIA-A	Phoenix	Maricopa County	0	32,071	37,280	37,280	37,280	37,280	37,280	37,280
CAP NIA-A	Chandler	Maricopa County	0	3,376	3,924	3,924	3,924	3,924	3,924	3,924
CAP NIA-A	Gilbert	Maricopa County	0	1,322	1,537	1,537	1,537	1,537	1,537	1,537
CAP NIA-A	Glendale	Maricopa County	0	587	682	682	682	682	682	682
CAP NIA-A	Mesa	Maricopa County	0	4,775	5,551	5,551	5,551	5,551	5,551	5,551
CAP NIA-A	Scottsdale	Maricopa County	0	2,844	3,306	3,306	3,306	3,306	3,306	3,306
CAP NIA-A	Tempe	Maricopa County	0	20	23	23	23	23	23	23
CAP NIA-B	Buckeye	Maricopa County	0	2,786	2,786	2,786	2,786	2,786	2,786	2,786
CAP NIA-B	Central Arizona Groundwater Replenishment District (CAGRD)	Maricopa County	0	18,185	18,185	18,185	18,185	18,185	18,185	18,185
CAP NIA-B	Carefree Water Company	Maricopa County	0	112	112	112	112	112	112	112
CAP NIA-B	Cave Creek	Maricopa County	0	386	386	386	386	386	386	386
CAP NIA-B	El Mirage	Maricopa County	0	1,318	1,318	1,318	1,318	1,318	1,318	1,318
CAP NIA-B	EPCOR, San Tan (ST)	Pinal County	0	3,217	3,217	3,217	3,217	3,217	3,217	3,217
CAP NIA-B	Freeport	Pima County	0	5,678	5,678	5,678	5,678	5,678	5,678	5,678
CAP NIA-B	Gilbert	Maricopa County	0	1,832	1,832	1,832	1,832	1,832	1,832	1,832
CAP NIA-B	Marana	Pima County	0	515	515	515	515	515	515	515
CAP NIA-B	Queen Creek	Maricopa County	0	4,162	4,162	4,162	4,162	4,162	4,162	4,162
CAP NIA-B	Resolution Copper	Maricopa County	0	2,238	2,238	2,238	2,238	2,238	2,238	2,238
CAP NIA-B	Rosemont Copper	Pima County	0	1,124	1,124	1,124	1,124	1,124	1,124	1,124
CAP NIA-B	SRP	Maricopa County	0	2,160	2,160	2,160	2,160	2,160	2,160	2,160
CAP NIA-B	Water Utilities Community Facilities District, Apache Junction	Pinal County	0	817	817	817	817	817	817	817
3	City of Yuma[1]	Yuma County	0	0	0	0	0	0	0	0
3	Union Pacific Railroad (formerly Southern Pacific Co.)	Yuma County	0	0	0	0	0	0	0	0
3	Kaman, Inc.	Yuma County	0	0	0	0	0	0	0	0
3	Department of the Navy, MCAS	Yuma County	0	0	0	0	0	0	0	0
3	City of Yuma (cemetery)	Yuma County	0	0	0	0	0	0	0	0
3	Yuma Mesa Fruit Growers' Association	Yuma County	0	0	0	0	0	0	0	0

Summary of Consumptive Use Impacts on Domestic Uses			Range of Analyzed Volumes of Total Shortage to Lower Division States (AF)							
Arizona			**200,000**	**533,000**	**617,000**	**867,000**	**917,000**	**967,000**	**1,017,000**	**1,100,000**
Priority	**Entitlement Holder**	**County**	-	-	-	-	-	-	-	-
3	Desert Lawn Memorial Park Association	Yuma County	0	0	0	0	0	0	0	0
3	Chandler (Salt River Pima-Maricopa Exchange)	Maricopa County	0	0	0	0	0	0	0	0
3	Gilbert (Salt River Pima-Maricopa Exchange)	Maricopa County	0	0	0	0	0	0	0	0
3	Glendale (Salt River Pima-Maricopa Exchange)	Maricopa County	0	0	0	0	0	0	0	0
3	Mesa (Salt River Pima-Maricopa Exchange)	Maricopa County	0	0	0	0	0	0	0	0
3	Phoenix (Salt River Pima-Maricopa Exchange)	Maricopa County	0	0	0	0	0	0	0	0
3	Scottsdale (Salt River Pima-Maricopa Exchange)	Maricopa County	0	0	0	0	0	0	0	0
3	Tempe (Salt River Pima-Maricopa Exchange)	Maricopa County	0	0	0	0	0	0	0	0
3	Department of the Army - Yuma Proving Ground	Yuma County	0	0	0	0	0	0	0	0
3	Yuma Union High School District	Yuma County	0	0	0	0	0	0	0	0
2	Cibola National Wildlife Refuge	La Paz County	0	0	0	0	0	0	0	0
2	Lake Mead National Recreation Area	Mohave County	0	0	0	0	0	0	0	0
2	Bureau of Reclamation - Davis Dam	Mohave County	0	0	0	0	0	0	0	0
2	Imperial National Wildlife Refuge	La Paz County	0	0	0	0	0	0	0	0
2	Havasu Lake National Wildlife Refuge	Mohave County	0	0	0	0	0	0	0	0
		Subtotal	**0**	**89,525**	**96,833**	**128,162**	**128,162**	**128,162**	**128,162**	**179,364**

California			-	-	-	-	-	-	-	-
Priority	**Entitlement Holder**	**County**	-	-	-	-	-	-	-	-
4	Metropolitan Water District of Southern California (MWD) (4)	Los Angeles, Orange, San Diego, Riverside, San Bernardino	0	0	0	186,000	232,500	279,000	325,500	325,500
3	MWD Diversions from QSA (3a from IID and CVWD)		0	0	0	0	0	0	0	0
-	-	**Subtotal**	**0**	**0**	**0**	**186,000**	**232,500**	**279,000**	**325,500**	**325,500**

Nevada			-	-	-	-	-	-	-	-
Priority	**Entitlement Holder**	**County**	-	-	-	-	-	-	-	-
8 - Balance & Surplus	Southern Nevada Water Authority (SNWA)	Clark	8,000	21,000	25,000	27,000	27,000	27,000	27,000	30,000
8	Big Bend Water District	Clark	0	0	0	0	0	0	0	0
8	Robert B. Griffith Project	Clark	0	0	0	0	0	0	0	0
7	Southern Nevada Water Authority (Formerly Boy Scouts of America)	Clark	0	0	0	0	0	0	0	0
7	Bureau of Reclamation (includes Sportsman Park)	Clark	0	0	0	0	0	0	0	0
7	Nevada Dept. of Wildlife (formerly NV Dept of Game & Fish)	Clark	0	0	0	0	0	0	0	0
7	US Air Force (4,000af) (Delivery from SNWA)	Clark	0	0	0	0	0	0	0	0
6	Las Vegas Valley Water District	Clark	0	0	0	0	0	0	0	0
5	Lakeview Company (Hacienda Casino)	Clark	0	0	0	0	0	0	0	0
5	Pacific Coast Building Products, Inc. (PABCO)	Clark	0	0	0	0	0	0	0	0
4	Basic Water Company (formerly Basic Management, Inc.)	Clark	0	0	0	0	0	0	0	0
4	City of Henderson	Clark	0	0	0	0	0	0	0	0
4	Southern Nevada Water Authority (From Basic Water Company)	Clark	0	0	0	0	0	0	0	0
3	Boulder City	Clark	0	0	0	0	0	0	0	0
2	Lake Mead National Recreation Area4, Executive Order No. 5339	Clark	0	0	0	0	0	0	0	0
-	-	**Subtotal**	**8,000**	**21,000**	**25,000**	**27,000**	**27,000**	**27,000**	**27,000**	**30,000**
-	-	**Total**	**8,000**	**110,525**	**121,833**	**341,162**	**387,662**	**434,162**	**480,662**	**534,864**

Summary by County			-	-	-	-	-	-	-	-
-	**Arizona**	**# of Entitlement Holders /County**	-	-	-	-	-	-	-	-
-	Coconino County	1	0	0	0	0	0	0	0	0
-	Gila County	2	0	0	0	156	156	156	156	390
-	La Paz County	11	0	0	0	0	0	0	0	1
-	Maricopa County	56	0	78,174	85,482	104,683	104,683	104,683	104,683	134,332
-	Mohave County	18	0	0	0	0	0	0	0	3,314
-	Pima County	13	0	7,317	7,317	17,986	17,986	17,986	17,986	34,031
-	Pinal County	8	0	4,034	4,034	5,337	5,337	5,337	5,337	7,296
-	Yuma County	16	0	0	0	0	0	0	0	0
-	**Subtotal Arizona Domestic**	**125**	**0**	**89,525**	**96,833**	**128,162**	**128,162**	**128,162**	**128,162**	**179,364**

Summary by County			-	-	-	-	-	-	-	-
-	**California**	-	-	-	-	-	-	-	-	-
-	Los Angeles, Orange, San Diego, Riverside, San Bernardino	6	0	0	0	186,000	232,500	279,000	325,500	325,500
-	**Subtotal California Domestic**	**6**	**0**	**0**	**0**	**186,000**	**232,500**	**279,000**	**325,500**	**325,000**
-	**Nevada**	-	-	-	-	-	-	-	-	-
-	Clark	15	8,000	21,000	25,000	27,000	27,000	27,000	27,000	30,000
-	**Subtotal Nevada Domestic**	**15**	**8,000**	**21,000**	**25,000**	**27,000**	**27,000**	**27,000**	**27,000**	**30,000**

[1]This user also holds a PPR entitlement, which is not affected at these levels of shortages, and it was not included here.

Note: PPRs are not affected at these levels of shortage.

Note: Orange highlights indicate the level at which available water for a user under this priority is reduced to zero.

Note: This analysis does not reflect an operational estimate of when water may cease to be physically available to certain users.

Disclaimer: These modeling results from the Shortage Allocation Model should only be used to compare the relative magnitude of effects reasonably expected to occur under the alternatives evaluated in this SEIS. Modeling assumptions should not be taken as agency position with respect to contract or statutory interpretation, and they are not intended to limit Secretarial discretion with respect to current or future policy. This model is not a substitute for the annual process of reviewing water orders and determining which can be filled, and it cannot replicate the precision required for that process.

E.3.5 Relationship between CRMMS and the Shortage Allocation Model

CRMMS was used to model a variety of river and reservoir parameters in the Colorado River Basin, including shortage amounts, reservoir elevations, and river flows (**Appendix D**, CRMMS Model Documentation). The Shortage Allocation Model provides a more detailed allocation of shortages to entitlement holders in the Lower Division States, specifically within Arizona.

The Shortage Allocation Model does not account for the use or conversion of ICS to meet DCP contributions, and it models DCP contributions as shortages to Lower Division States and users. CRMMS can model the conversion of Extraordinary Conversion ICS to DCP ICS for purposes of meeting DCP contributions without reducing diversions in a specific year.

In CRMMS, when Lake Mead is projected to decline to dead pool (elevation 895 feet) and all downstream water demands cannot be met, water users are modeled to be shorted "hydrologically", i.e., upstream users access water before downstream users. In this case, system shortages are reported as a total for the entire Lower Basin because there are no explicit assumptions made in CRMMS associated with how these shortages are distributed in the Lower Basin. The Shortage Allocation Model does not attempt to represent the effect of potential system shortages and how these shortages might be distributed should such conditions occur, or the effect of physical limitations on access to water due to low river stage.

Furthermore, the distribution of shortage within each state according to the Shortage Allocation Model is slightly different than CRMMS, because CRMMS uses projected water depletion schedules for distributing the available water supply to individual users in Arizona, California, and Nevada. For the first year of the model run, water depletion schedules use water orders that reflect the current year's actual shortage conditions, DCP contributions, and other signed system conservation agreements. For the remaining years in the model run, default water depletion schedules reflect "normal" schedules, and they represent near-term historical trends in water use. For California and Nevada, the Shortage Allocation Model assumes entitlement holders in these states are using their full entitlements and distributes available water on that basis. For Arizona, the methods for distributing available water vary between priorities in the Shortage Allocation Model, but they are not based on CRMMS schedules.

E.4 Changes Made to the Shortage Allocation Modeling and this Appendix E After Publication of the Original Draft SEIS in April 2023

E.4.1 Water Transfer from GSC Farm, LLC to Town of Queen Creek

On April 28, 2023, a partial assignment and transfer of Arizona P4(i) Colorado River water was finalized from GSC Farm, LLC to the Town of Queen Creek. Tables E-5, E-14, and E-15 have been revised accordingly, and the Shortage Allocation Model reflects an updated proportionate share of the Arizona P4(i) entitlement pool for both GSC Farm, LLC and the Town of Queen Creek. (See **Section E.3.2.5.3** for more information.)

E.4.2 Removal of Previous Action Alternatives 1 and 2 From Consideration

As described in Chapters 1 and 2 of this SEIS, shortages under the 2007 Interim Guidelines and contributions pursuant to the 2019 DCP are the basis for the alternatives now under consideration; accordingly, the Shortage Allocation Model results described in this Appendix E are limited to the effects of the 2007 Interim Guidelines and 2019 DCP.

E.4.3 Refinement to Attribution of California DCP Contributions

The Shortage Allocation Model described in this Appendix E attributes 7% of California's DCP contributions to Coachella Valley Water District pursuant to the May 20, 2019, Drought Contingency Plan Implementation Agreement Between Metropolitan Water District of Southern California and Coachella Valley Water District.

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Attachment E-1

Reclamation's September 14, 2022, letter notifying interested parties of a Tier 2 Shortage Condition and required DCP contributions in operational year 2023

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United States Department of the Interior

BUREAU OF RECLAMATION
P.O. Box 61470
Boulder City, NV 89006-1470

IN REPLY REFER TO:
LCB-4200
2.2.4.23

Subject: Notification of Tier 2 Shortage Condition and Drought Continency Plan (DCP) Contributions for the Lower Colorado River in Calendar Year (CY) 2023

Dear Interested Party:

On December 13, 2007, the Secretary of the Interior signed the Record of Decision for *Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead* (2007 Interim Guidelines), which, among other things, identified operational strategies for managing the reservoirs of the Colorado River System under drought and low reservoir conditions. In accordance with the process set forth in the 2007 Interim Guidelines, the Secretary uses the August 24-Month Study projections for the following January 1 system storage and reservoir water surface elevations to determine Lake Mead operations for the following CY. In accordance with the 2007 Interim Guidelines, the Annual Operating Plan for Colorado River Reservoirs for CY 2023 will document the Secretary's determination, which affects the volume of mainstream Colorado River water available for use in CY 2023 within the Lower Division States of Arizona, California, and Nevada.

On August 16, 2022, the Bureau of Reclamation released its Colorado River Basin August 2022 24-Month Study, which projects Lake Mead's January 1, 2023, operating determination elevation to be 1,047.61 feet.[1] Following the release of the August 2022 24-Month Study, Reclamation announced that Lake Mead and the lower Colorado River will operate in a Tier 2 Shortage Condition in CY 2023, consistent with Section XI.G.2.D.1.b of the 2007 Interim Guidelines and in accordance with Article III(3)(c) of the *Criteria For Coordinated Long-Range Operation of Colorado River Reservoirs* and Article II(B)(3) of the 2006 Consolidated Decree of the United States Supreme Court in *Arizona* v. *California*. In addition, the *Lower Basin Drought Contingency Plan Agreement* (LB DCP Agreement) dated May 20, 2019, will also govern the operation of Lake Mead for CY 2023. The projected operation determination elevation of 1,047.61 feet is within the DCP elevation band of 1,045 and 1,050 feet and reflects what is commonly referred to a "Tier 2a" Shortage Condition.

In accordance with the 2007 Interim Guidelines and the LB DCP Agreement, the Tier 2a Shortage Condition results in the following mandatory shortage reductions and DCP Contributions in CY 2023:

[1]The CY 2023 operating determination elevation of 1,047.61 feet was calculated by taking Lake Mead's projected end of CY 2022 physical elevation of 1,040.78 feet, as reported in the August 2022 24-Month Study, and adding 480,000 acre-feet (AF) of water held back in Lake Powell to Lake Mead's capacity to maintain operational neutrality. For more information: https://www.usbr.gov/lc/region/g4000/24mo/.

- Arizona: a shortage reduction of 400,000 AF and DCP Contributions of 192,000 AF, for a total reduction of 592,000 AF, which is approximately 21 percent of the state's annual basic apportionment of 2.8 million AF of Colorado River water.
- Nevada: a shortage reduction of 17,000 AF and DCP Contributions of 8,000 AF, for a total reduction of 25,000 AF, which is 8 percent of the state's annual basic apportionment of 300,000 AF of Colorado River water.
- California: There is no shortage reduction or DCP Contributions required for California in CY 2023.

Additionally, in accordance with Minute 323 to the 1944 Water Treaty,[2] Mexico's Colorado River water delivery will be reduced in the amount of 70,000 AF and Mexico will contribute 34,000 AF of Mexico's Recoverable Water Savings to the Binational Water Scarcity Contingency Plan,[3] for a total Colorado River water delivery reduction of 104,000 AF, which is approximately 7 percent of Mexico's annual allotment of 1.5 million AF of Colorado River water.

Arizona Operations in CY 2023

In accordance with Section XI.G.2.D.1.b of the 2007 Interim Guidelines, 2.4 million AF is apportioned for consumptive use in the state of Arizona in CY 2023 (a reduction of 400,000 AF from its 2.8 million AF basic apportionment). Additionally, in accordance with Section III.B.1.a of Exhibit 1 to the LB DCP Agreement,[4] the state of Arizona will be required to make DCP Contributions in the total amount of 192,000 AF in CY 2023. Consistent with the Arizona mainstream Colorado River water priority system, there are no reductions to the water supply available to first, second and third priority entitlement holders for CY 2023.

Reclamation will implement the state of Arizona's August 6, 2009,[5] Arizona Shortage Sharing Recommendation and the "pool" approach described by letter dated January 25, 2021,[6] to distribute the available Arizona fourth priority Colorado River water supply. Consistent with the Arizona mainstream Colorado River water priority system, the pool approach recognizes that the fourth priority Colorado River water entitlements of the "on-river" mainstream users and the Central Arizona Project (CAP) are co-equal. The Arizona fourth priority Colorado River water available supply for CY 2023 is 1,078,962 AF,[7] which will be shared between the on-river mainstream entitlement holders and CAP. Reclamation anticipates that the available fourth priority supply will be sufficient to satisfy all on-river mainstream water orders, and is coordinating with the Central Arizona Water Conservation District on the distribution of available water supply within the CAP.

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[2] Referring to *Extension of Cooperative Measures and Adoption of a Binational Water Scarcity Contingency Plan in the Colorado River Basin*. Available at: https://www.ibwc.gov/Files/Minutes/Min323.pdf.

[3] The implementing details of Mexico's Binational Water Scarcity Contingency Plan are provided in the *Joint Report of the Principal Engineers with the Implementing Details of the Binational Water Scarcity Contingency Plan in Colorado River Basin*. Available at: https://www.ibwc.gov/Files/joint_report_min323_bi_water_scarcity_contingency_plan_final.pdf.

[4] Referring to *Lower Basin Drought Contingency Operations*. Available at: https://www.usbr.gov/lc/region/g4000/dcpdocs/Attachment-B-Exhibit-1-LB-Drought-Operations.pdf.

[5] Available at: https://new.azwater.gov/sites/default/files/8-6-2009_ADWR_Shortage_%20ecommendation.pdf.

[6] Available at: https://new.azwater.gov/sites/default/files/01.25.21_ADWR_CAWCD_shortage_recommendationLetter.pdf.

[7] Calculated as Arizona's 2.8 million AF basic apportionment, less the average historical consumptive use by Arizona first, second, and third priority users (1,129,038 AF), less the required shortage reduction (400,000 AF), less the required DCP Contributions (192,000 AF). The average historical consumptive use by Arizona first, second, and third priority users is based on the four highest years of consumptive use during the five-year period from 2017-2021.

No unused Arizona mainstream water entitlement will be available for use by Arizona fifth priority mainstream water entitlement holders.

California Operations in CY 2023

In accordance with Section XI.G.2.D.1.b of the 2007 Interim Guidelines, 4.4 million AF is apportioned for consumptive use in the state of California in CY 2023 (no reduction from its basic apportionment). In accordance with Section III.B of Exhibit 1 to the LB DCP Agreement, the state of California is not required to make DCP Contributions in CY 2023.

Nevada Operations in CY 2023

In accordance with Section XI.G.2.D.1.b of the 2007 Interim Guidelines, 283,000 AF is apportioned for consumptive use in the state of Nevada in CY 2023 (a reduction of 17,000 AF from its 300,000 AF basic apportionment). Additionally, in accordance with Section III.B.2.a of Exhibit 1 to the LB DCP Agreement, the state of Nevada is required to make DCP Contributions in the total amount of 8,000 AF in CY 2023. The Southern Nevada Water Authority (SNWA) is the junior priority entitlement holder in the state of Nevada and SNWA and its member agencies hold entitlements of 276,000 AF per year of the state of Nevada's annual 300,000 AF basic apportionment. Pursuant to its cooperative agreement among its member agencies, as amended, SNWA may implement a shortage plan among its member agencies and can coordinate with them to absorb Colorado River water use reductions. SNWA does not, however, anticipate a need for shared reductions in Colorado River water deliveries in CY 2023 because Nevada's total annual consumptive use is anticipated to be lower than the reduced quantity of Colorado River water that will be available in CY 2023.

Lower Colorado River Basin-wide Considerations

Given the projections that Lake Mead's elevation will continue to decline in CY 2023, Reclamation encourages all Colorado River entitlement holders to prudently manage the use of available water supplies. Additionally, Reclamation would like to highlight that, in accordance with the *Inadvertent Overrun and Payback Policy*,[8] **accumulations of inadvertent overruns are not permitted in CY 2023 and are suspended as long as a Shortage Condition is in in effect**. To assist entitlement holders in monitoring their Colorado River water use to ensure they remain within available quantities, Reclamation will project diversions and consumptive use of Colorado River water during CY 2023 and will make these projections available daily on Reclamation's website.[9] Reclamation encourages Colorado River water entitlement holders to use the projections to adjust diversions to remain within their Reclamation-approved annual Colorado River water order.

[8] Available at: https://www.usbr.gov/lc/region/g4000/IOPP.pdf.
[9] Available at: https://www.usbr.gov/lc/region/g4000/hourly/forecast.pdf.

My staff will continue to monitor Colorado River hydrology and water use. We are available to work with you before and during shortage operations. Should you have questions, please contact Daniel A. Bunk, Chief, Boulder Canyon Operations Office, at (702) 293-8013 or dbunk@usbr.gov. Individuals in the United States, who are deaf, deafblind, hard of hearing, or have a speech disability may dial 711 (TTY, TDD, or TeleBraille) to access telecommunication relay services. Individuals outside the United States should use the relay services offered within their country to make international calls to the point-of-contact in the United States.

Sincerely,

JACKLYNN GOULD

Digitally signed by JACKLYNN GOULD
Date: 2022.09.14 13:54:52 -07'00'

Jacklynn L. Gould, P.E.
Regional Director

Attachment E-2

Reclamation's September 28, 2022, letter to the Central Arizona Water Conservation District announcing the operational year 2023 Available CAP Supply

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United States Department of the Interior

BUREAU OF RECLAMATION
P.O. Box 61470
Boulder City, NV 89006-1470

IN REPLY REFER TO:
PXAO-3000
2.2.4.21

VIA ELECTRONIC MAIL ONLY

Theodore C. Cooke
General Manager
Central Arizona Water Conservation District
23636 North 7th Street
Phoenix, AZ 85024

Subject: Calendar Year (CY) 2023 Announcement of Available Central Arizona Project (CAP) Supply

Dear Theodore C. Cooke:

As the Regional Director of the Lower Colorado Basin Region of the Bureau of Reclamation, who is delegated the authority and responsibility of the Secretary of the Interior, the "water master" on the lower Colorado River and the "Contracting Officer" for CAP contracts, I am hereby announcing the Available CAP Supply for the upcoming CY in accordance with contractual commitments. The Available CAP Supply for CY 2023 is 940,836 acre-feet (AF).

As you know, the Colorado River is the primary source of CAP water. Therefore, the Available CAP Supply for CY 2023 is primarily determined by and is subject to the availability of Colorado River water in CY 2023. The Secretary determines the water supply condition on the lower Colorado River for the upcoming year in accordance with the Consolidated Decree in *Arizona* v. *California* 547 U.S. 150 (2006), the *Criteria for Coordinated Long-Range Operation of Colorado River Reservoirs Pursuant to the Colorado River Basin Project Act of September 30, 1968 (Public Law 90-537)* as amended, and the procedures set forth in the *Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operation for Lake Powell and Lake Mead* (2007 Guidelines) and the Lower Basin Drought Contingency Plan Agreement (LB DCP Agreement).

In its letter dated September 14, 2022 (enclosed), Reclamation announced that Lake Mead and the lower Colorado River will operate in a Tier 2a Shortage Condition in CY 2023 with Drought Contingency Plan (DCP) Contributions required, reducing the volume of Colorado River water available to the state of Arizona by 592,000 AF. As noted in the September 14th letter's overview of Arizona operations in CY 2023, the Arizona fourth priority Colorado River water available supply for CY 2023 is 1,078,962 AF on a consumptive use (CU) basis. Of that

amount, 106,318 AF,[1] on a diversion basis, will be available for distribution among mainstream fourth priority or "P4(i)" entitlement holders for use in CY 2023 in accordance with the state of Arizona's August 6, 2009,[2] Arizona Shortage Sharing Recommendation and the "pool" approach described by letter dated January 25, 2021.[3] The remainder is available for diversion as fourth priority water by CAP to fulfill CAP contracts and subcontracts.

Contract No. 14-06-W-245, Amendment No. 2, Between the United States and the Central Arizona Water Conservation District for the Delivery of Water and Repayment of Costs of the Central Arizona Project, dated November 30, 2007, defines Available CAP Supply as "… for any given Year all Fourth Priority Water available for delivery through the Central Arizona Project, water available from CAP dams and reservoirs other than Modified Roosevelt Dam, and return flows captured by the Secretary for CAP use." Available CAP Supply, as calculated below for CY 2023, will be used in contractual determinations related to a CAP Time of Shortage and the distribution of water among CAP contractors and subcontractors.

Determinant of Available CAP Supply	**AF of CU for CY 2023**
Fourth Priority Supply	1,078,962
Minus P4(i) Available Supply (CU Equivalent of 106,318 AF)	- 65,917
Minus Other Use in Arizona[4]	- 809
Equals Fourth Priority Water Available to CAP Contractors and Subcontractors at the CAP Point of Diversion	**= 1,012,236**
Minus CAP System Loss Associated with Fourth Priority CAP Project Water	- 71,400
Plus Water Available from CAP Dams and Reservoirs other than Modified Roosevelt Dam	+ 0
Plus Return Flows Captured by the Secretary for CAP Use	+ 0
Equals Available CAP Supply	**= 940,836**

The Available CAP Supply is the amount of fourth priority water that Reclamation estimates will be available and can be committed for delivery to CAP contractors and subcontractors in CY 2023. However, the Central Arizona Water Conservation District must adjust its CY 2023 CAP Colorado River water diversion as needed to remain within the diversion volume approved by Reclamation that reflects uses by higher priority Colorado River water entitlement holders as they occur during CY 2023. As Reclamation works throughout the basin to adapt to these unprecedented drought conditions, the Lower Colorado Basin Regional Office and the Phoenix Area Office are committed to ongoing coordination with CAP stakeholders.

[1] The P4(i) pool will receive 9.85% of the Arizona fourth priority Colorado River water available for CY 2023, calculated as 164,652 AF divided by the difference between Arizona's 2,800,000 AF basic apportionment and the average historical consumptive use by Arizona first, second, and third priority users (1,129,038 AF). The average historical consumptive use by Arizona first, second, and third priority users is based on the four highest years of consumptive use during the five-year period from 2017-2021.

[2] Available at: https://new.azwater.gov/sites/default/files/8-6-2009_ADWR_Shortage_%20ecommendation.pdf.

[3] Available at: https://new.azwater.gov/sites/default/files/01.25.21_ADWR_CAWCD_shortage_recommendationLetter.pdf.

[4] Three-year average of consumptive use on Cibola Island and outside Present Perfected Right No. 7

Should you have questions, please contact Alexander B. Smith, Deputy Area Manager, Phoenix Area Office, at (623) 773-6215 or alexandersmith@usbr.gov. Individuals in the United States, who are deaf, deafblind, hard of hearing, or have a speech disability may dial 711 (TTY, TDD, or TeleBraille) to access telecommunication relay services. Individuals outside the United States should use the relay services offered within their country to make international calls to the point-of-contact in the United States.

Sincerely,

Acting for STACY WADE

Digitally signed by STACY WADE
Date: 2022.09.28 09:44:46 -07'00'

Jacklynn L. Gould, P.E.
Regional Director

Enclosure

cc: Thomas Buschatzke
Director
Arizona Department of Water Resources
1110 W. Washington Street, Suite 310
Phoenix, AZ 85007

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Attachment E-3

Exhibit 5.3.4.1 to the Tohono O'odham Settlement Agreement, *Secretary's Approach for Determining the Amount of Water Available to the Nation During a Time of Shortage Under 1980 Contract*

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EXHIBIT 5.3.4.1

SECRETARY'S SHORTAGE SHARING APPROACH

UNDER THE 1980 CONTRACT

Secretary's Approach for Determining
The Amount of Water Available to the Nation
During a Time of Shortage Under 1980 Contract

If the Available CAP Supply is insufficient to fill all orders for CAP water, the Secretary shall take the following steps, in succession, as necessary to match the available supply with orders for the delivery of CAP water in each of the categories described below:

1. First, miscellaneous uses of CAP water are reduced, pro rata. If, after eliminating all miscellaneous uses of CAP water, there is still insufficient available CAP water to meet outstanding orders for the delivery of CAP water, the Secretary shall take the following measure.

2. Uses of CAP NIA Priority Water are reduced, pro rata. If, after eliminating all uses of CAP NIA Priority Water, there is still insufficient available CAP water to meet outstanding orders for delivery of CAP water, then the Secretary shall take the following measure.

3. Uses of CAP M&I Priority Water in excess of 510,000 acre-feet are reduced, pro rata. If, after eliminating all uses of CAP M&I Priority Water in excess of 510,000 acre-feet, there is still insufficient available CAP water to meet outstanding orders for delivery of CAP water, then the Secretary shall take the following measure.

4. If the preceding reductions do not bring CAP water orders in line with the Available CAP Supply, uses of CAP Indian Priority Water in excess of 291,574 acre-feet are reduced, in accordance with the Secretarial Decision published in the Federal Register on March 24, 1983.

5. If the preceding reductions do not bring CAP water orders in line with the Available CAP Supply, the available CAP water supply will be allocated between users of CAP Indian Priority Water and users of CAP M&I Priority Water on a 36.37518 and 63.62482 percentage basis, respectively.

6. If step 5 is implemented, the amount of water available for the Nation shall be determined by multiplying the amount of CAP Indian Priority Water by the ratio of the amount of water delivered pursuant to the Nation's CAP Water Delivery Contract in the latest non-shortage Year relative to the total quantity of water delivered to all CAP Contracts for Indian Priority Water in that same Year.

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Appendix F

Potential DROA Contributions Sensitivity Analysis on Proposed Action

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Attachment

F-1 CRMMS Modeling Assumptions

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Appendix F. Potential DROA Contributions Sensitivity Analysis on Proposed Action

F.1 Introduction

Potential DROA contributions are analyzed in this appendix to provide a comparative analysis of the effects of potential DROA contributions on the Proposed Action.

F.2 Modeling Approach

This section summarizes the assumptions that were used in the hydrologic modeling and metrics used to compare the Proposed Action (with no DROA contributions) with the Proposed Action with potential DROA contributions (hereafter referred to as Proposed Action, DROA). Future Colorado River system conditions during the analysis period for both alternatives were simulated using the June 2023 CRMMS.

F.2.1 Modeling Assumptions

The following section summarizes the assumptions for the Proposed Action, DROA. The Proposed Action is described in **Chapter 2** with detailed modeling assumptions in **Section 3.3.4** and **Appendix D**.

The hydrologies used in this appendix are derived from the June 2023 Colorado Basin River Forecast Center Ensemble Streamflow Prediction (ESP) Upper Basin forecast and associated Lower Basin intervening flows. Three sets of ESPs are used in the SEIS modeling:

- 100 percent ESP: no adjustment to the streamflow forecasts
- 90 percent ESP: streamflow forecasts are reduced by 10 percent
- 80 percent ESP: streamflow forecasts are reduced by 20 percent

Detailed hydrology inputs, initial conditions, and other modeling assumptions not described in the following sections are consistent with assumptions included in the Proposed Action (see **Appendix D**).

Assumptions for the Proposed Action with Potential DROA Contributions

Modeling assumptions are consistent with the Proposed Alternative assumptions in **Section 3.3.4**. Additional assumptions for potential DROA contributions are summarized below. Detailed assumptions for CRMMS can be found in **Appendix D**.

- The modeling assumption regarding potential DROA contributions of up to 500,000 af per DROA year (May 1–April 30) will conform to the DROA and its implementing documents; the assumption also will be made only to help protect a Lake Powell elevation of 3,500 feet. These potential DROA contributions of zero to 500,000 af are modeled to occur if the projected Lake Powell end-of-water-year pool elevation is less than 3,525 feet for 2024 through 2026.

F.2.2 Comparison Metrics

The Proposed Action and Proposed Action, DROA are compared in **Section F.4** using the following metrics:

Lake Powell

- Monthly pool elevation
- Percentages of traces that fall below an elevation of 3,490 feet in any month in a water year
- Annual water year release

Lake Mead

- Monthly pool elevation
- Percentages of traces that fall below an elevation of 1,020 feet in any month in a calendar year
- Annual calendar year release

F.3 Modeling Results

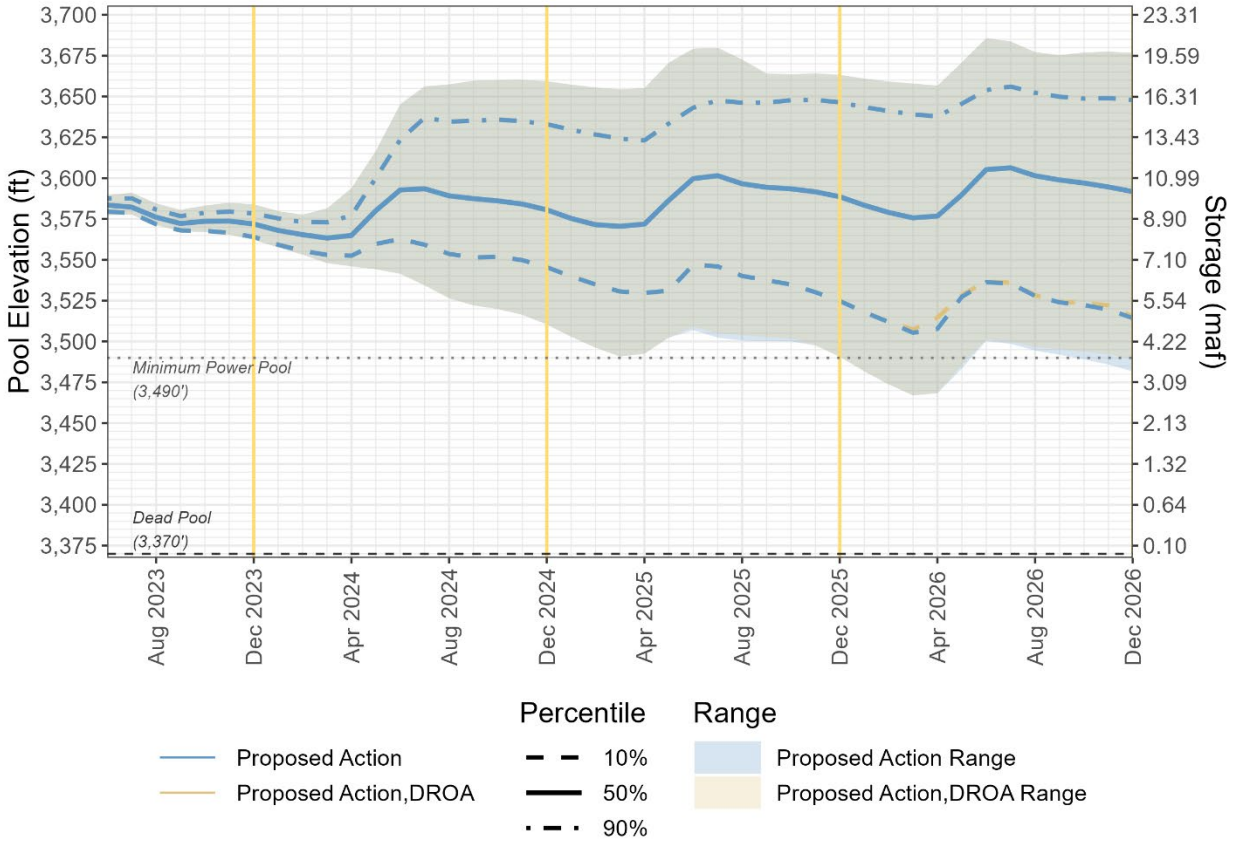
This section compares the Proposed Action with the Proposed Action, DROA. All statistics calculated reflect the hydrology scenarios and other assumptions used in modeling; they are not intended to suggest actual probabilities of any events occurring. However, it is meaningful to compare statistics across alternatives to differentiate performance. See **Appendix D** for more information about the hydrology scenarios used and modeling assumptions.

F.3.1 Lake Powell

Monthly Pool Elevations

Figure F-1 presents a comparison of the 10th, 50th, and 90th percentiles of modeled Lake Powell elevations for both alternatives as dashed, solid, and dash-dotted lines, respectively. It also shows "clouds" representing the full ranges of modeled elevations for the alternatives through 2026.

Figure F-1
Lake Powell End-of-Month Pool Elevations



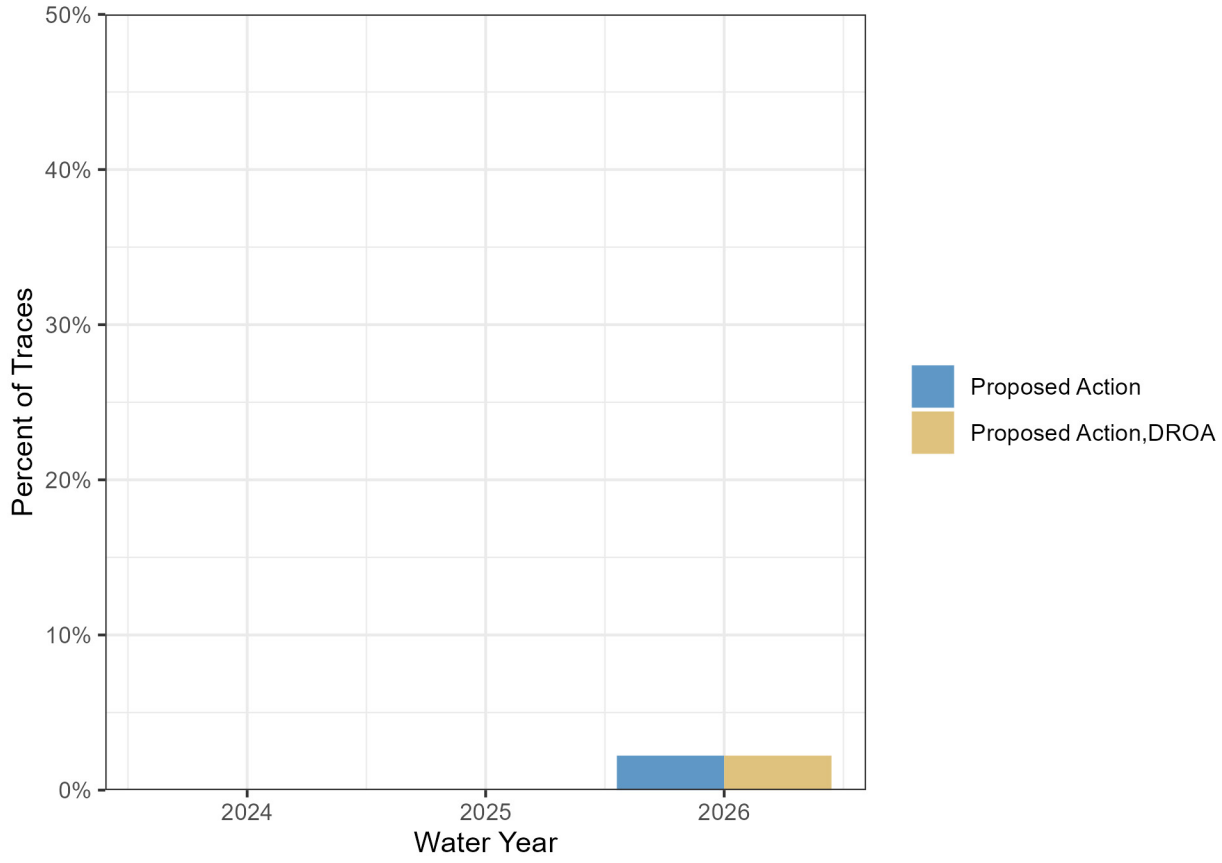
The median, 90th percentile, and highest modeled Lake Powell elevations in **Figure F-1** are exactly the same for the Proposed Action and the Proposed Action, DROA. The 10th percentile and minimum modeled pool elevations show slight differences as the pool elevations drop to 3,525 feet, which triggers DROA contributions. Modeled DROA releases are triggered in 3 percent of traces in 2025 and 9 percent of traces in 2026. In 2026, the Proposed Action, DROA has a slightly higher pool elevation at the 10th percentile—with a minimum in March 2026 of 3,507 feet compared to 3,505 feet under the Proposed Action—resulting from increased inflow into Lake Powell from modeled DROA releases.

Percentages of Traces below Critical Elevations

Figure F-2 shows the percentage of modeled traces that fall below a Lake Powell elevation of 3,490 feet at any time during a year for 2024 through 2026. Remaining above 3,490 feet is critical to ensuring that Glen Canyon Dam can continue to operate as designed.

Figure F-2 shows the same percentage of traces drop below a Lake Powell pool elevation of 3,490 feet for both alternatives. Under the Proposed Action and Proposed Action, DROA, 2 percent of traces in 2026 result in the Lake Powell pool elevation dropping below 3,490 feet.

Figure F-2
Lake Powell Minimum Water Year Elevation, Percentage of Traces Less than an Elevation of 3,490 feet

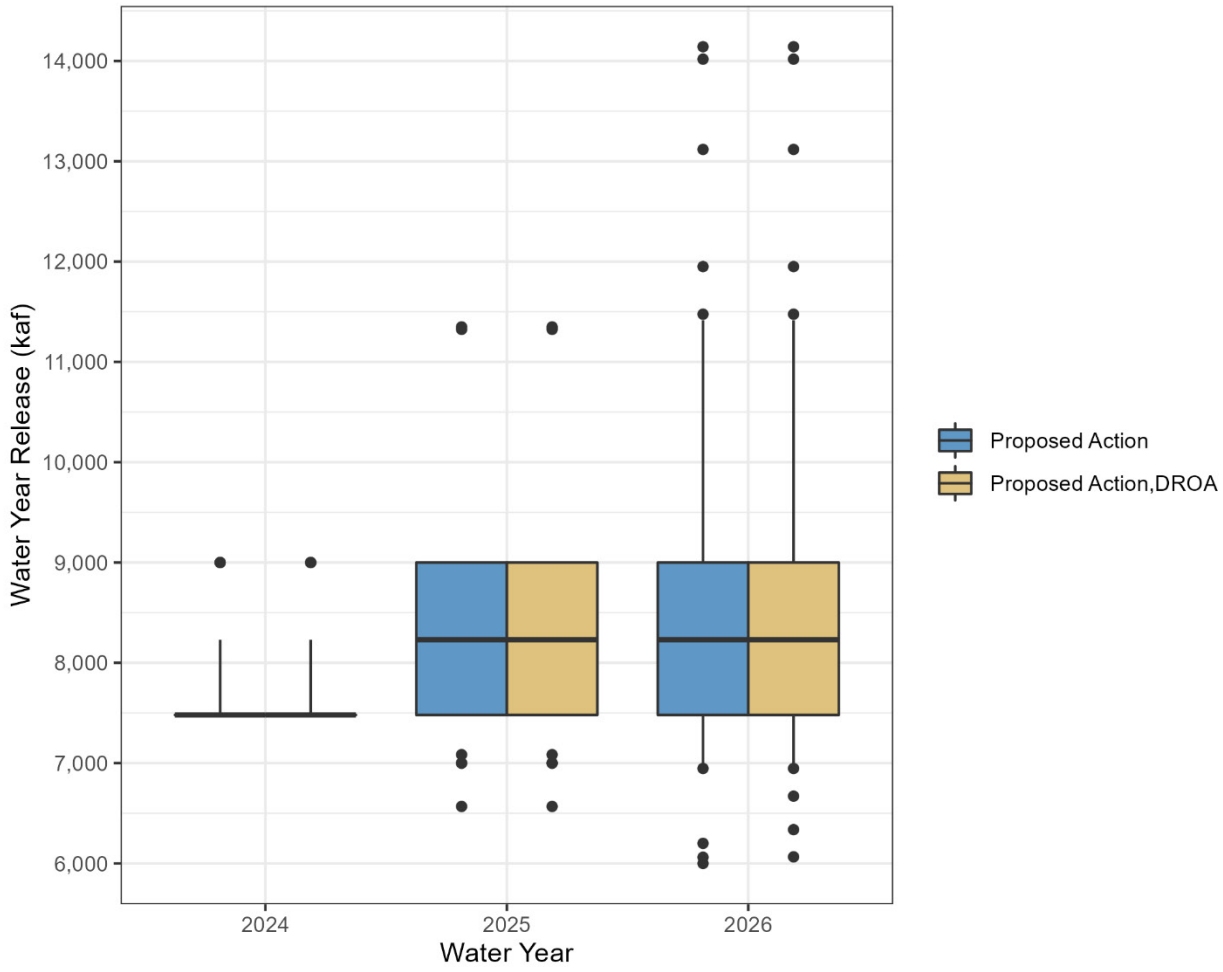


Annual Releases

Figure F-3 shows the distributions of modeled Glen Canyon Dam water year releases in 2024, 2025, and 2026. The top and bottom of each box capture the 25th to 75th percentile, respectively, of the modeled elevations. The median is the mid-line of the box, the whiskers extend to the 5th and 95th percentiles, and the outliers are represented as dots beyond these lines.

The modeled Glen Canyon Dam water year releases shown in **Figure F-3** reflect small differences in Glen Canyon Dam's annual release that result from potential DROA releases from the Upper Basin Upper Initial Units. The releases for 2024 and 2025 are the same, reflecting that DROA releases do not impact Glen Canyon Dam releases during these years. In 2026, when Glen Canyon Dam releases were reduced below 7.0 maf to protect 3,500 feet, the lowest 5 percent of releases were affected by potential DROA contributions. In these modeled traces, extra inflows to Lake Powell from potential DROA contributions slightly increased Lake Powell's storage, allowing for more water to be released.

Figure F-3
Glen Canyon Dam Water Year Release



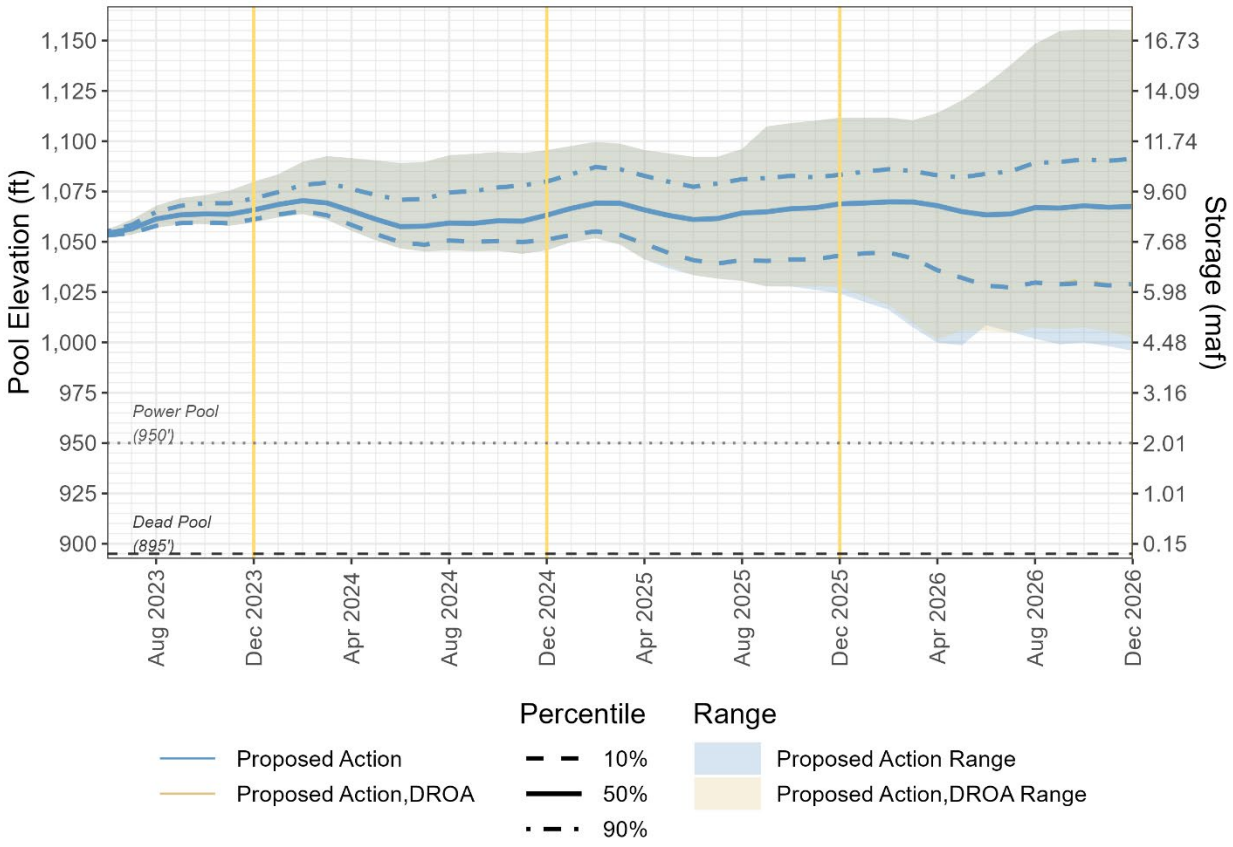
F.3.2 Lake Mead

Monthly Pool Elevations

Figure F-4 presents a comparison of the 10th, 50th, and 90th percentiles of modeled Lake Mead elevations for all alternatives as dashed, solid, and dash-dotted lines, respectively. It also shows clouds representing the full ranges of modeled elevations for the alternatives through 2026.

In **Figure F-4**, the only differences between the modeled Lake Mead elevation occur at the lower bound or minimum pool elevation starting in water year 2026. The Proposed Action, DROA pool elevations are slightly higher than those for the Proposed Action by 7 feet at the end of 2026; this is due to changes in Glen Canyon Dam's release.

Figure F-4
Lake Mead End-of-Month Pool Elevations

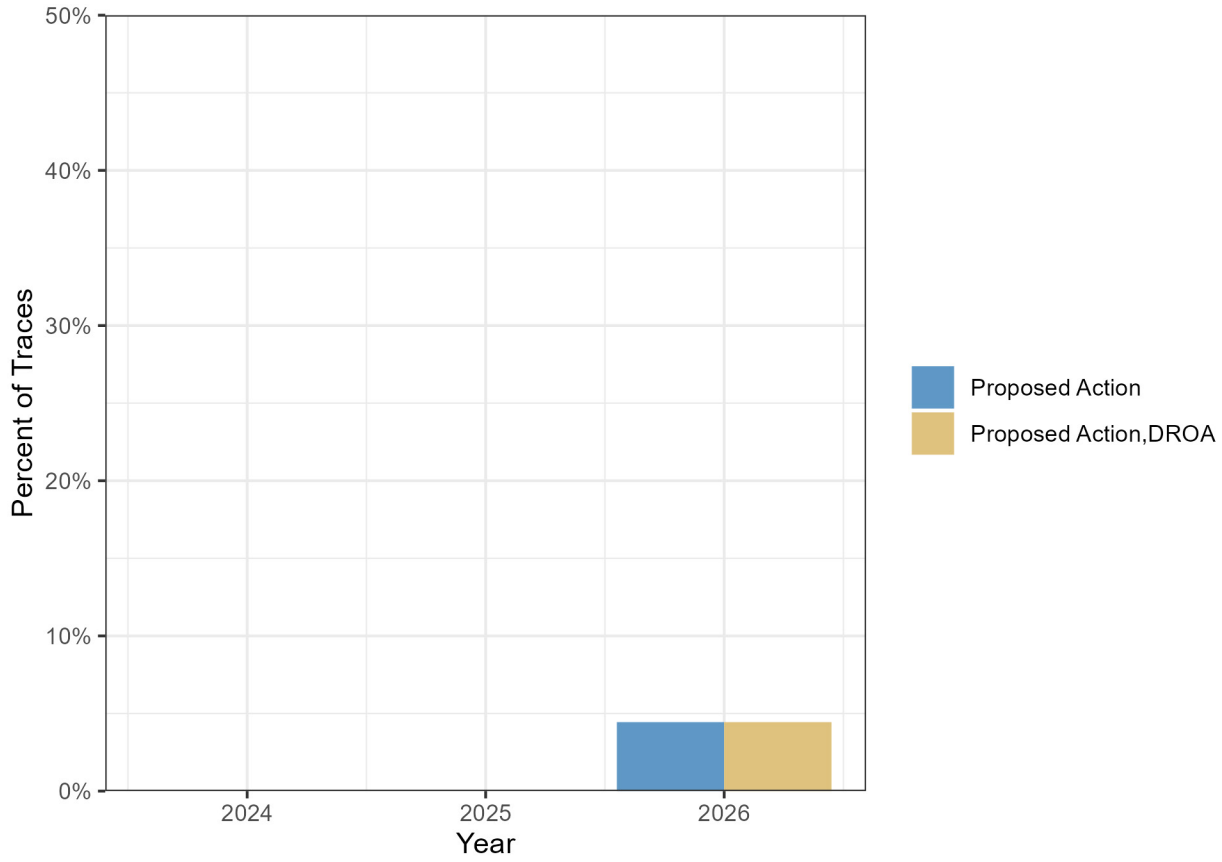


Percentages of Traces below Critical Elevations

Figure F-5 shows the percentage of modeled traces that fall below a Lake Mead elevation of 1,000 feet at any time during a year for the period of analysis. An elevation of 1,020 feet was identified as a critical elevation in the 2019 DCP.

In **Figure F-5**, the Proposed Action and Proposed Action, DROA have no modeled traces falling below a Lake Mead elevation of 1,020 feet in 2024 and 2025. In 2026, both alternatives show 4 percent of traces falling below 1,020 feet; this shows that DROA releases do not affect the percentage of traces dropping below 1,020 feet at Lake Mead.

Figure F-5
Lake Mead Minimum Calendar Year Elevation, Percentage of Traces Less than Elevation of 1,020 feet

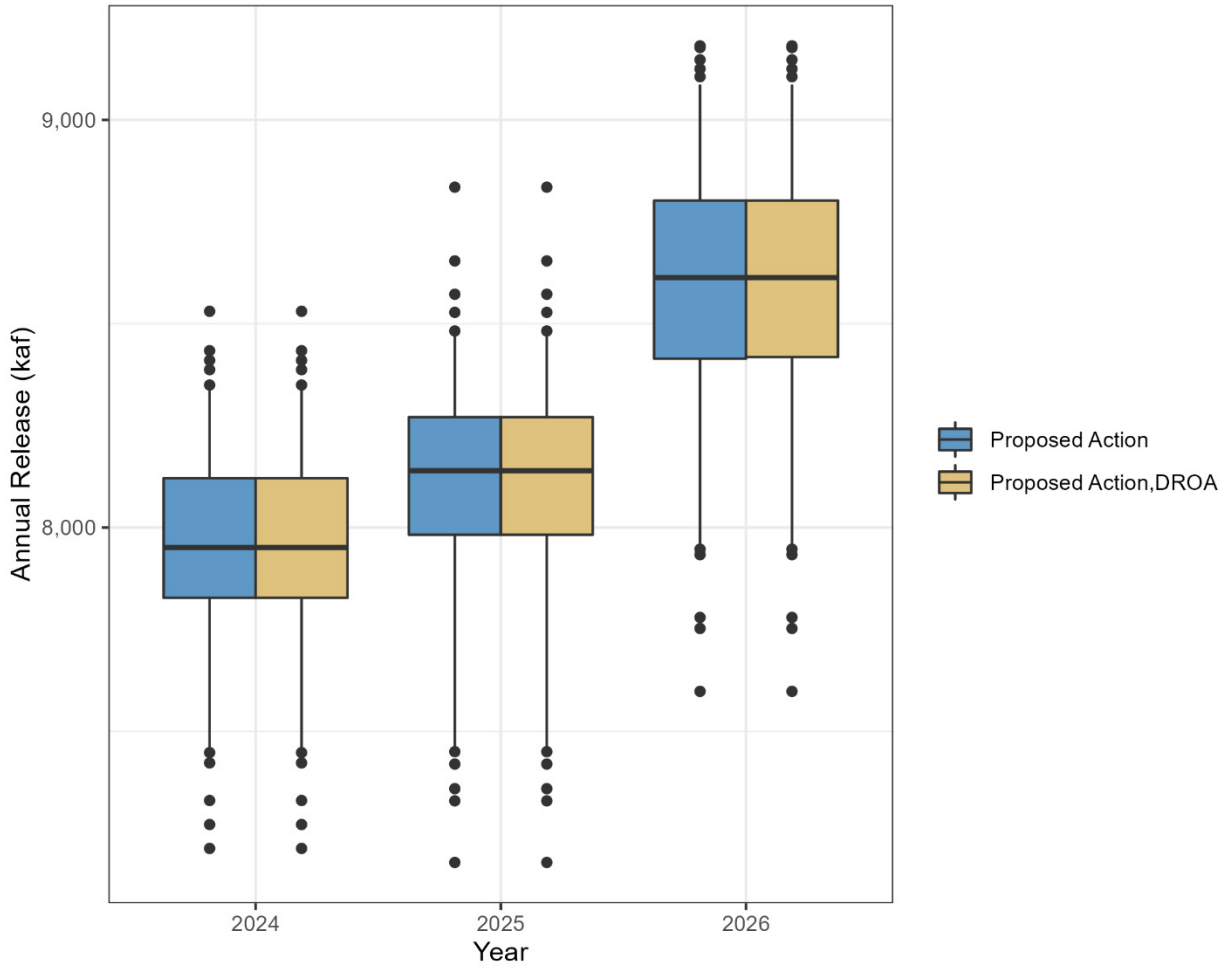


Annual Releases

Figure F-6 shows the distributions of modeled annual releases from Hoover Dam in 2024, 2025, and 2026. The top and bottom of each box capture the 25th to 75th percentile, respectively, of the modeled elevations. The median is the mid-line of the box, the whiskers extend to the 5th and 95th percentiles, and the outliers are represented as dots beyond these lines.

Figure F-6 shows that modeled releases from Hoover Dam in 2024 to 2025 are the same. In 2026, there are some minor differences in Lake Mead's release. Due to slightly increased Glen Canyon Dam releases resulting from DROA contributions, 2 percent of modeled traces result in lower shortage and DCP contributions in 2026.

Figure F-6
Hoover Dam Calendar Year Release



F.4 Summary

The potential DROA contributions have a minimal impact on Lake Powell and Lake Mead operations, except under the driest modeled traces. In the driest traces, which reduce Glen Canyon Dam's releases below 7.0 maf to protect 3,500 feet, the potential DROA contributions increase Lake Powell pool elevations and releases from Glen Canyon Dam compared to the Proposed Action. At Lake Mead, the Proposed Action, DROA has slightly higher pool elevations for traces projecting the minimum Lake Mead pool elevations. This affects the shortage tier and DCP contributions in 2026; 2 percent of traces have lower reductions resulting from increased releases from Glen Canyon Dam.

Attachment F-1

CRMMS Modeling Assumptions

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Attachment F-1. CRMMS Modeling Assumptions

This attachment describes the CRMMS modeling assumptions for potential DROA contributions.

F-1.1 Potential DROA Contribution Assumptions

CRMMS includes modeling assumptions for potential DROA contributions to Lake Powell for DROA Years 2024 through 2026 (that is, May 2024 through the end of the simulation). Potential DROA contributions range from zero to 500,000 af per DROA Year when Lake Powell is projected to be below 3,525 feet at the end of the operating year, depending on the water available for potential DROA contributions from Flaming Gorge, Navajo, and Blue Mesa Reservoirs. Potential DROA contributions are distributed proportionally across Flaming Gorge, Navajo, and Blue Mesa Reservoirs based on each reservoir's storage above key reservoir elevation targets.

In CRMMS, the potential DROA contribution is calculated in August of run cycle 4. The rules are a higher priority than the Lake Powell operations; therefore, they solve after the Lake Powell operating tier and operating year releases have been calculated. The potential DROA contributions are only assumed to occur if Lake Powell is projected to be below 3,525 feet during Lake Powell's initial calculation in the Lower Elevation Balancing Tier. The potential DROA contributions' rules then distribute up to an additional 500,000-af release from Flaming Gorge, Blue Mesa, and Navajo Reservoirs.

To determine the portion of the 500,000-af additional release applied to Flaming Gorge, Blue Mesa, and Navajo Reservoirs, the available storage that can be released from all three reservoirs is calculated. For Flaming Gorge Reservoir, the storage available for a DROA contribution is calculated by taking the difference between the projected storage at the end of the DROA year (that is, April in the following operating year) and the storage at 5,890 feet (19 feet above minimum power pool). For Blue Mesa Reservoir, the storage available for a DROA contribution is calculated by taking the difference between the storage at the end of December of the following year and the storage at 7,412 feet (19 feet above minimum power pool). For Navajo Reservoir, the storage available for a DROA contribution is calculated by taking the difference between the projected storage at the end of September of the following year and the storage at 6,050 feet (60 feet above the Navajo Indian Irrigation Project diversion intake).

The total available storage for DROA contributions is calculated as the sum of each reservoir's available storage volume. If the total available storage for DROA contributions is less than 500,000 af, then the potential DROA contribution is set to the volume of available storage. Each reservoir's storage available for a DROA contribution is constrained to be nonnegative.

The percentages of the potential DROA contributions from Flaming Gorge, Blue Mesa, and Navajo Reservoirs are calculated as:

$$PotentialContributionPercent_i = \frac{AvailableStorage_i}{\sum_i AvailableStorage_i}$$

where i is each reservoir (Flaming Gorge, Blue Mesa, and Navajo).

The potential DROA contributions are released over the DROA Year using the monthly proportions in **Table F-1-1**. These monthly distributions are based off the monthly distribution of DROA releases in past planned DROA releases (that is, DROA Year 2022 for Flaming Gorge Reservoir and 2021 for Blue Mesa and Navajo Reservoirs).

Table F-1-1
Monthly Distribution of Potential DROA Contributions

Month	Flaming Gorge Reservoir	Blue Mesa Reservoir	Navajo Reservoir
	Percent	Percent	Percent
January	8.58	0.00	0.00
February	7.78	0.00	0.00
March	8.58	0.00	0.00
April	4.79	0.00	0.00
May	21.56	0.00	0.00
June	2.40	0.00	0.00
July	3.59	0.00	0.00
August	9.78	38.89	0.00
September	9.58	50.00	0.00
October	7.58	11.11	0.00
November	7.19	0.00	50.00
December	8.59	0.00	50.00

In the calculation of monthly releases for the DROA year, the additional DROA contribution is added to the reservoir's current release. The new projected release is then constrained to ensure it would not cause the reservoir to drop below dead pool or below the Navajo Indian Irrigation Project diversion at Navajo. Morrow Point and Crystal Reservoirs are then resolved for the DROA Year since their inflow has been adjusted due to the potential DROA contributions. These reservoirs adjust their outflow to ensure they stay at their storage targets, passing the DROA contribution from Blue Mesa Reservoir.

Appendix G

Table of Sensitive Species

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Appendix G. Table of Sensitive Species

Common Name	Scientific Name	Listing Status	Location					Potential Species Impacts?
			Lake Powell	Glen Canyon Dam to Lake Mead	Lake Mead	Hoover Dam to the SIB	Salton Sea	
Fish								
Bluehead sucker	*Catostomus discobolus*	BLM AZ BLM UT	—	X	X (rare)	—	—	Yes
Bonytail	*Gila elegans*	Endangered BLM NV	X (rare, stocked)	—	—	X (stocked)	—	Yes
Colorado pikeminnow	*Ptychocheilus lucius*	Endangered	X	—	—	—	—	Yes
Desert pupfish	*Cyprinodon macularis*	Endangered	—	—	—	Present in small numbers in riverside marshes	Present in agriculture drains (not reported in Salton Sea since 2007)	Yes
Desert sucker	*Catostomus clarkii*	BLM AZ	—	—	—	X	—	Found only in tributaries—not in the project area
Flannelmouth sucker	*Catostomus latipinnis*	BLM AZ BLM UT	X	X	X	X	—	Yes
Gila longfin dace	*Agosia chrysogaster chrysogaster*	BLM AZ	—	—	—	X	—	No; found in tributaries, not in the project area
Humpback chub	*Gila cypha*	Threatened	—	X	X	—	—	Yes; present in inflow to Lake Mead

Common Name	Scientific Name	Listing Status	Location					Potential Species Impacts?
			Lake Powell	Glen Canyon Dam to Lake Mead	Lake Mead	Hoover Dam to the SIB	Salton Sea	
Pahrump poolfish	*Empetrichthys latos*	BLM NV	—	—	—	—	—	Not present in the project area
Razorback sucker	*Xyrauchen texanus*	Endangered BLM NV	X	X	X	X	—	Yes
Roundtail chub	*Gila robusta*	BLM AZ BLM UT	X	X	X	X	—	Not in the project area; does not occur downstream of Mesquite, Nevada
Sonora sucker	*Catostomus insignis*	—	—	—	—	X	—	No; found in tributaries, not in the project area
Speckled dace	*Rhinichthys osculus*	BLM AZ	X	X	X	X	—	Yes; found in the mainstem Colorado River and tributaries
Virgin spinedace	*Lepidomeda mollispinis*	BLM Sensitive	—	—	X	—	—	Not in the project area; this species does not occur downstream of Mesquite, Nevada
Woundfin	*Plagopterus argentissimus*	—	—	—	X	—	—	Not present in the project area; does not occur downstream of Mesquite, Nevada
Birds								
American peregrine falcon	*Falco peregrinus*	BLM AZ BLM NV	X	X	X	X	X	No. This species forages over diverse habitat types, and it nests on exposed cliffs and buildings, which will not be impacted by any alternative.
American white pelican	*Pelicanus erythrorhynchos*	BLM UT	X	X	—	X	X	Yes
Arizona Bell's vireo	*Vireo bellii arizonae*	BLM CA	—	X	—	X	—	Yes

Common Name	Scientific Name	Listing Status	Location					Potential Species Impacts?
			Lake Powell	Glen Canyon Dam to Lake Mead	Lake Mead	Hoover Dam to the SIB	Salton Sea	
Arizona grasshopper sparrow	*Ammodramus savannarum ammolegus*	BLM AZ	—	X	X	X	—	No. This species utilizes dry upland grassland habitat for foraging and nesting, which will not be impacted by any alternative.
Bald eagle	*Haliaeetus leucocephalus*	BLM AZ BLM NV BLM UT	X	X	X	X	—	Yes
Bank swallow	*Riparia riparia*	BLM CA	—	—	—	X	—	No. This species is a migrant that does not breed in the analysis area. It would not be impacted by any alternative.
Bendire's thrasher	*Toxostoma bendirei*	BLM CA	—	—	—	X	—	No. This species utilizes dry grassland and desert habitat for foraging and nesting, which will not be impacted by any alternative.
Black swift	*Cypseloides niger*	BLM UT	X	—	—	—	—	No. This species forages over diverse habitat types. It nests behind waterfalls, which will not be impacted by any alternative.
Burrowing owl	*Athene cunicularia*	BLM UT BLM NV	X	—	X	X	X	No. This species utilizes dry grassland and desert habitat for foraging and nesting, which will not be impacted by any alternative.

Common Name	Scientific Name	Listing Status	Location					Potential Species Impacts?
			Lake Powell	Glen Canyon Dam to Lake Mead	Lake Mead	Hoover Dam to the SIB	Salton Sea	
Cactus ferruginous pygmy owl	*Glaucidium brasilianum cactorum*	BLM AZ	—	X	X	X	—	No. This species utilizes desert habitat with cacti for foraging and nesting; these will not be impacted by any alternative.
California black rail	*Laterallus jamaicensis coturniculus*	BLM AZ BLM CA	—	—	—	X	X	Yes
California brown pelican	*Pelecanus occidentalis californicus*	BLM CA	—	X	—	X	—	No. This species is rarely detected.
California condor	*Gymnogyps californianus*	BLM AZ	X	X	—	—	—	Yes
Crissal thrasher	*Toxostoma crissale*	BLM CA	—	—	—	X	X	Yes
Elf owl	*Micrathene whitneyi*	BLM CA	—	—	—	X	—	Yes
Ferruginous hawk	*Buteo regalis*	BLM UT	X	—	—	—	—	No. This species forages over diverse habitat types. It nests on exposed cliffs or solitary trees or infrastructure, which will not be impacted by any alternative.
Gila woodpecker	*Melanerpes uropygialis*	BLM CA	—	—	—	X	—	Yes
Gilded flicker	*Colaptes chrysoides*	BLM AZ BLM CA	—	—	—	X	—	Yes
Golden eagle	*Aquila chrysaetos*	BLM UT BLM AZ	X	X	X	X	—	Yes

Common Name	Scientific Name	Listing Status	Location					Potential Species Impacts?
			Lake Powell	Glen Canyon Dam to Lake Mead	Lake Mead	Hoover Dam to the SIB	Salton Sea	
Least bittern	*Ixobrychus exilis*	BLM NV	—	X	X	X	X	No. This species is not found in habitat that would be impacted by any alternatives.
LeConte's thrasher	*Toxostoma lecontei*	BLM AZ	—	X	X	X	—	No. This species utilizes dry and desert habitat types for foraging and nesting; these will not be impacted by any alternative.
Lucy's warbler	*Vermivora luciae*	BLM CA	X	—	—	X	—	Yes
Mountain plover	*Charadrius montanus*	BLM CA	—	—	—	X	X	Yes
Northern goshawk	*Accipiter gentilis*	BLM AZ	—	X	—	—	—	No. This species utilizes upland forested habitat with high canopy cover for foraging and nesting; this habitat will not be impacted by any alternative.
Phainopepla	*Phainopepla nitens*	BLM NV	—	X	X	X	—	No. This species utilizes habitat that would not be impacted by any alternative.
Southwestern willow flycatcher	*Empidonax traillii extimus*	Endangered BLM AZ BLM CA BLM NV	—	X	X	X	—	Yes
Swainson's hawk	*Buteo swainsoni*	BLM CA	—	—	—	X	—	No. This species forages over diverse habitat types, which will not be impacted by any alternative.
Tricolored blackbird	*Agelaius tricolor*	BLM CA	—	—	—	X	—	Yes

Common Name	Scientific Name	Listing Status	Location					Potential Species Impacts?
			Lake Powell	Glen Canyon Dam to Lake Mead	Lake Mead	Hoover Dam to the SIB	Salton Sea	
Western snowy plover	*Charadrius nivosus nivosus*	BLM NV	—	—	X	—	—	No. This species is not present in any habitat that would be impacted by any of the alternatives.
Western yellow-billed cuckoo	*Coccyzus americanus*	Threatened BLM AZ BLM CA BLM NV	—	X	X	X	—	Yes
White-tailed kite	*Elanus leucurus*	BLM CA	—	—	—	X	X	Yes
Yuma Ridgeway's rail	*Rallus obsoletus yumaniensis*	Endangered BLM AZ BLM CA BLM NV	—	X	X	X	X	Yes
Mammals								
Allen's big-eared bat	*Idionycteris phyllotis*	BLM AZ BLM NV BLM UT	X	—	X	—	—	Yes
Allen's lappet-browed bat	*Idionycteris phyllotis*	BLM AZ	—	X	—	—	—	Yes
Arizona myotis	*Myotis occultus*	BLM AZ	—	X	X	X	—	Yes
Big brown bat	*Eptesicus fuscus*	BLM NV	X	X	X	X	—	Yes
Big free-tailed bat	*Nyctinomops macrotis*	BLM NV	—	—	X	X	—	Yes
California leaf-nosed bat	*Macrotus californicus*	BLM AZ BLM NV	—	—	X	X	—	Yes
California myotis	*Myotis californicus*	BLM NV	X	X	X	X	—	Yes
Canyon bat	*Parastrellus hesperus*	BLM NV	X	X	X	X	—	Yes

Common Name	Scientific Name	Listing Status	Location					Potential Species Impacts?
			Lake Powell	Glen Canyon Dam to Lake Mead	Lake Mead	Hoover Dam to the SIB	Salton Sea	
Cave myotis	*Myotis velifer*	BLM AZ BLM NV	X	X	X	X	—	Yes
Desert bighorn sheep	*Ovis canadensis nelsoni*	BLM CA	X	X	X	X	—	Yes
Fringed myotis	*Myotis thysanodes*	BLM UT BLM NV	X	X	X	—	—	Yes
Hoary bat	*Lasiurus cinereus*	BLM NV	X	—	X	X	—	Yes
Houserock Valley chisel-toothed kangaroo rat	*Dipodomys microps leucotis*	BLM AZ	—	X	—	—	—	No. This species utilizes dry and desert habitat types for foraging; these will not be impacted by any alternative.
Kit fox	*Vulpes macrotis*	BLM UT	X	—	—	—	—	No. This species utilizes dry and desert habitat types for foraging and denning; these will not be impacted by any alternative.
Long-eared myotis	*Myotis evotis*	BLM CA	—	—	—	X	—	Yes
Mexican free-tailed bat	*Tadarida brasiliensis*	BLM NV	X	X	X	X	—	Yes
Mexican long-tongued bat	*Choeronycteris mexicana*	BLM AZ	—	X	—	X	—	Yes
Pale Townsend's big-eared bat	*Corynorhinus townsendii pallescens*	BLM AZ	X	X	X	X	—	Yes
Pallid bat	*Antrozous pallidus*	BLM NV	X	X	X	X	—	Yes

Common Name	Scientific Name	Listing Status	Location					Potential Species Impacts?
			Lake Powell	Glen Canyon Dam to Lake Mead	Lake Mead	Hoover Dam to the SIB	Salton Sea	
Palm Springs pocket mouse	*Perognathus longimembris bangsi*	BLM CA	—	—	—	X	—	No. This species utilizes dry and desert habitat types for foraging; these will not be impacted by any alternative.
Palm Springs round-tailed ground squirrel	*Xerospermophilus tereticaudus chlorus*	BLM CA	—	—	—	X	—	No. Not in the project area.
Silver-haired bat	*Lasionycteris noctivagans*	BLM NV	X	X	X	X	—	Yes
Spotted bat	*Euderma maculatum*	BLM AZ BLM NV BLM UT	—	X	—	X	—	Yes
Townsend's big-eared bat	*Corynorhinus townsendii*	BLM AZ BLM CA BLM NV BLM UT	X	—	X	X	—	Yes
Western mastiff bat	*Eumops perotis*	BLM NV	—	X	X	X	—	Yes
Western red bat	*Lasiurus blossevillii*	BLM NV BLM UT	—	—	X	X	—	Yes
Western small-footed myotis	*Myotis ciliolabrum*	BLM CA BLM NV	—	—	X	X	—	Yes
Yuma myotis	*Myotis yumanensis*	BLM CA BLM NV	X	X	X	X	—	Yes
Reptiles and Amphibians								
Arizona striped whiptail	*Aspidoscelis arizonae*	BLM AZ	—	X	X	X	—	No. This species utilizes upland habitat, which will not be impacted by any alternative.

Common Name	Scientific Name	Listing Status	Location					Potential Species Impacts?
			Lake Powell	Glen Canyon Dam to Lake Mead	Lake Mead	Hoover Dam to the SIB	Salton Sea	
Arizona toad	*Anaxyrus microscaphus*	BLM UT BLM NV	X	—	—	X	—	Yes
Banded Gila monster	*Heloderma suspectum cinctum*	BLM NV	—	X	X	X	—	No. This species utilizes upland habitat, which will not be impacted by any alternative.
Coast horned lizard	*Phrynosoma blainvillii*	BLM CA	—	—	—	X	—	No. This species utilizes upland habitat, which will not be impacted by any alternative.
Coronado skink	*Plestiodon skiltonianus interparietalis*	BLM CA	—	—	—	X	—	No. This specie's range is outside of areas impacted by any alternatives.
Couch's spadefoot	*Scaphiopus couchii*	BLM CA	—	—	—	X	—	Yes
Desert box turtle	*Terrapene ornata luteola*	BLM AZ	—	X	X	X	—	No. This species does not occur in habitat that would be impacted by any alternative.
Desert tortoise	*Gopherus agassizii*	BLM NV	—	—	X	X	—	No. This species utilizes upland habitat, which will not be impacted by any alternative.
Flat-tailed horned lizard	*Phrynosoma mcallii*	BLM AZ	—	—	—	X	—	No. This species utilizes upland habitat, which will not be impacted by any alternative.
Foothill yellow-legged frog (south coast DPS)	*Rana boylii*	BLM CA	—	—	—	X	—	No. This specie's range is outside of areas impacted by any alternatives.
Greater short-horned lizard	*Phrynosoma hernandesi*	BLM NV	X	X	X	X	X	No. This species utilizes upland habitat, which will not be impacted by any alternative.

Common Name	Scientific Name	Listing Status	Location					Potential Species Impacts?
			Lake Powell	Glen Canyon Dam to Lake Mead	Lake Mead	Hoover Dam to the SIB	Salton Sea	
Lowland burrowing treefrog	*Smilisca fodiens*	BLM AZ	—	X	X	X	—	No. This specie's range is outside of areas impacted by any alternatives.
Lowland leopard frog	*Rana yavapaiensis*	BLM AZ BLM CA	—	—	X	X	—	Yes
Mohave fringe-toed lizard	*Uma scoparia*	BLM AZ	—	X	X	X	—	No. This species utilizes upland habitat, which will not be impacted by any alternative.
Northern leopard frog	*Lithobates [=Rana] pipens*	BLM AZ	X	X	—	—	—	No. This species utilizes habitat in side canyons off of Lake Powell, which will not be impacted by any alternative.
Northern Mexican gartersnake	*Thamnophis eques megalops*	Threatened	—	—	X	X	—	Yes
Relict leopard frog	*Rana onca*	BLM AZ BLM NV	—	X	X	X	—	Yes
Sinaloan narrow-mouthed toad	*Gastrophryne mazatlanensis*	BLM AZ	—	X	X	X	—	No. This species does not occur in habitat that would be impacted by any alternative.
Sonoran green toad	*Bufo retiformis*	BLM AZ	—	X	X	X	—	No. This species does not occur in habitat that would be impacted by any alternative.
Two-striped Gartersnake	*Thamnophis hammondii*	BLM CA	—	—	—	X	—	No. This species does not occur in habitat that would be impacted by any alternative.
Western pond turtle	*Emys marmorata*	BLM CA	—	—	—	X	—	No. This species does not occur in habitat that would be impacted by any alternative.

Common Name	Scientific Name	Listing Status	Location					Potential Species Impacts?
			Lake Powell	Glen Canyon Dam to Lake Mead	Lake Mead	Hoover Dam to the SIB	Salton Sea	
Western spadefoot	*Spea hammondii*	BLM CA	—	—	—	X	—	No. This species does not occur in habitat that would be impacted by any alternative.
Yuman desert fringe-toed lizard	*Uma rufopunctata*	BLM AZ	—	X	X	X	—	No. This species utilizes upland habitat, which will not be impacted by any alternative.
Invertebrates								
Apache springsnail	*Pyrgulopsis arizonae*	BLM AZ	—	X	X	X	—	No. This species is only known from a few locations that will not be influenced by project operations.
Gila tyronia	*Tryonia gilae*	BLM AZ	—	X	X	X	—	No. This species is only known from a few locations that will not be influenced by project operations.
Grand wash springsnail	*Pyrgulopsis bacchus*	BLM NV	—	X	X	X	—	No. This species is only found in a watershed feeding Lake Mead; this watershed will not be influenced by project operations.
Kingman springsnail	*Pyrgulopsis conica*	BLM AZ	—	X	X	X	—	No. This species is only known from a few locations that will not be influenced by project operations.
MacNeill's sooty-winged skipper	*Hesperopsis gracielae*	BLM NV	—	—	X	X	—	No. This species utilizes upland habitat, which will not be impacted by any alternative.

Common Name	Scientific Name	Listing Status	Location					Potential Species Impacts?
			Lake Powell	Glen Canyon Dam to Lake Mead	Lake Mead	Hoover Dam to the SIB	Salton Sea	
Mojave gypsum bee	*Andrena balsamorhizae*	BLM NV	—	—	X	—	—	No. This species is restricted to areas with its host plant, the sunray, which is an upland plant species.
Mojave poppy bee	*Perdita meconis*	BLM NV	—	—	X	—	—	Yes
Monarch butterfly	*Danaus plexippus plexippus*	BLM NV	X	X	X	X	—	Yes
Sonoran talussnail	*Sonorella magdalenensis*	BLM AZ	—	X	X	X	—	No. This species utilizes upland talus and rocky slopes, which will not be impacted by any alternative.
Thorne's hairstreak	*Callophrys thornei*	BLM CA	—	—	—	X	—	No. This species relies on tecate cypress, which will not be impacted by any alternative.
Plants								
Alkali mariposa lily	*Calochortus striatus*	BLM NV	—	—	X	—	—	No. This species' range is outside of areas impacted by any alternatives.
Aravaipa sage	*Salvia amissa*	BLM AZ	—	X	X	X	—	No. This species grows in habitat with silt or sand in dry canyon bottoms; this habitat will not be impacted by any alternative.
Aravaipa woodfern	*Thelypteris puberula* var. *sonorensis*	BLM AZ	—	X	—	—	—	No. This species is only known from locations that will not be impacted by any alternatives.

Common Name	Scientific Name	Listing Status	Location					Potential Species Impacts?
			Lake Powell	Glen Canyon Dam to Lake Mead	Lake Mead	Hoover Dam to the SIB	Salton Sea	
Arizona eryngo	*Eryngium sparganophyllum*	BLM AZ	—	X	X	X	—	No. This species is only known from a few locations that will not be influenced by project operations.
Arizona Sonora rosewood	*Vauquelinia californica* ssp. *sonorensis*	BLM AZ	—	X	X	X	—	No. This species grows in upland desert habitat, which will not be impacted by any alternative.
Bartram stonecrop	*Graptopetalum bartramii*	BLM AZ	—	X	X	X	—	No. This species is only known from a few locations that will not be influenced by project operations.
Beaver dam breadroot	*Pediomelum castoreum*	BLM NV	—	—	X	—	—	No. This species grows in upland desert habitat, which will not be impacted by any alternative.
Blue diamond cholla	*Cylindropuntia X multigeniculata*	BLM NV	—	—	X	—	—	No. This species grows in dry gypsiferous limestone, which will not be impacted by any alternative.
Blue sand lily	*Triteleiopsis palmeri*	BLM AZ	—	X	X	X	—	No. This species grows on sand dunes, which will not be impacted by any alternative.
California flannelbush	*Fremontodendron californicum*	BLM AZ	—	X	X	X	—	No. This species grows in well-draining rocky hillsides and ridges, which will not be impacted by any alternative.

Common Name	Scientific Name	Listing Status	Location					Potential Species Impacts?
			Lake Powell	Glen Canyon Dam to Lake Mead	Lake Mead	Hoover Dam to the SIB	Salton Sea	
California screw moss	*Tortula californica*	BLM CA	—	—	—	X	—	No. This species' range is outside of areas impacted by any alternatives.
Chaparral sand-verbena	*Abronia villosa var. aurita*	BLM CA	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.
Cochise sedge	*Carex ultra*	BLM AZ	—	X	X	X	—	No. This species is only known from a few locations that will not be influenced by project operations.
Coulter's goldfields	*Lasthenia glabrata ssp. coulteri*	BLM CA	—	—	—	X	—	No. This species' range is outside of areas impacted by any alternatives
Deane's milkvetch	*Astragalus deanei*	BLM CA	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.
Decumbent goldenbush	*Isocoma menziesii var. decumbens*	BLM CA	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.
Delicate clarkia	*Clarkia delicata*	BLM CA	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.
Dunn's mariposa lily	*Calochortus dunnii*	BLM CA	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.
Fish creek fleabane	*Erigeron piscaticus*	BLM AZ	—	X	X	X	—	No. This species is only known from a few locations that will not be influenced by project operations.

Common Name	Scientific Name	Listing Status	Location					Potential Species Impacts?
			Lake Powell	Glen Canyon Dam to Lake Mead	Lake Mead	Hoover Dam to the SIB	Salton Sea	
Felt-leaved monardella	*Monardella hypoleuca ssp. lanata*	BLM CA	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.
Gander's pitcher sage	*Lepechinia ganderi*	BLM CA	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.
Gander's ragwort	*Packera ganderi*	BLM CA	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.
Gold butte moss	*Ceratodon purpureus*	BLM NV	—	—	X	—	—	Yes
Grand Canyon rose	*Rosa stellata* var. *abyssa*	BLM AZ	—	X	—	—	—	No. This species grows in upland habitat, which will not be impacted by any alternative.
Harrison's barberry	*Berberis harrisoniana*	BLM AZ	—	X	X	X	—	No. This species grows on talus slopes on and along canyon sides, which will not be impacted by any alternative.
Harwood's eriastrum	*Eriastrum harwoodii*	BLM CA	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.
Hohokam agave	*Agave murpheyi*	BLM AZ	—	X	X	X	—	No. This species grows in upland desert, which will not be impacted by any alternative.
Horn's milk-vetch	*Astragalus hornii var. hornii*	BLM CA	—	—	—	X	—	No. This species grows in upland desert, which will not be impacted by any alternative.

Common Name	Scientific Name	Listing Status	Location					Potential Species Impacts?
			Lake Powell	Glen Canyon Dam to Lake Mead	Lake Mead	Hoover Dam to the SIB	Salton Sea	
Huachuca golden aster	*Heterotheca rutteri*	BLM AZ	—	X	X	X	—	No. This species is only known from a few locations that will not be influenced by project operations.
Lace-leaved rockdaisy	*Perityle ambrosiifolia*	BLM AZ	—	X	X	X	—	No. This species is only known from a few locations that will not be influenced by project operations.
Lakeside ceanothus	*Ceanothus cyaneus*	BLM CA	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.
Las Vegas bearpoppy	*Arctomecon californica*	BLM NV	—	—	X	—	—	No. This species grows in upland desert in gypsum soils, which will not be impacted by any alternative
Las Vegas buckwheat	*Eriogonum corymbosum* var. *nilesii*	BLM NV	—	—	X	—	—	No. This species grows in upland gypsum soils, which will not be impacted by any alternative.
Latimer's woodland-gilia	*Saltugilia latimeri*	BLM CA	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.
Lincoln rockcress	*Boechera lincolnensis*	BLM CA	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.
Little San Bernardino Mtns. linanthus	*Linanthus maculatus ssp. maculatus*	BLM CA	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.

Common Name	Scientific Name	Listing Status	Location					Potential Species Impacts?
			Lake Powell	Glen Canyon Dam to Lake Mead	Lake Mead	Hoover Dam to the SIB	Salton Sea	
Long-spined spineflower	*Chorizanthe polygonoides var. longispina*	BLM CA	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.
Marble Canyon milkvetch	*Astragalus cremnophylax* var. *hevronii*	BLM AZ	—	X	—	—	—	No. This species grows along canyon edges, which will not be impacted by any alternative.
Mecca-aster	*Xylorhiza cognata*	BLM CA	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.
Mojave indigo bush	*Psorothamnus arborescens*	BLM AZ	—	X	—	—	—	No. This species grows in upland desert, which will not be impacted by any alternative.
Mojave tarplant	*Deinandra mohavensis*	BLM CA	—	—	—	X	—	Yes
Mokiak milkvetch	*Astragalus mokiacensis*	BLM NV	—	—	X	—	—	Yes
Mount Trumbull beardtongue	*Penstemon distans*	BLM AZ	—	X	—	—	—	No. This species grows in upland forest/woodland habitat, which will not be impacted by any alternative.
Nuttall's scrub oak	*Quercus dumosa*	BLM CA	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.
Oil neststraw	*Stylocline citroleum*	BLM CA	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.
Orcutt's brodiaea	*Brodiaea orcuttii*	BLM CA	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.

Common Name	Scientific Name	Listing Status	Location					Potential Species Impacts?
			Lake Powell	Glen Canyon Dam to Lake Mead	Lake Mead	Hoover Dam to the SIB	Salton Sea	
Orocopia Mountains spurge	*Euphorbia jaegeri*	BLM CA	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.
Otay manzanita	*Arctostaphylos otayensis*	BLM CA	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.
Otay Mountain ceanothus	*Ceanothus otayensis*	BLM CA	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.
Parish's meadowfern	*Limnanthes alba ssp. parishii*	BLM CA	—	—	—	X	—	Yes
Parish's phacelia	*Phacelia parryi*	BLM NV	—	—	X	—	—	No. This specie's range is outside of areas impacted by any alternatives.
Parry's spineflower	*Chorizanthe parryi var. parryi*	BLM CA	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.
Parry's tetracoccus	*Tetracoccus dioicus*	BLM CA	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.
Pima Indian mallow	*Abutilono parishii*	BLM AZ	—	X	X	X	—	No. This species grows in upland desert, which will not be impacted by any alternative.
Pinto beardtongue	*Penstemon bicolor* ssp. *roseus*	BLM AZ	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.

Common Name	Scientific Name	Listing Status	Location					Potential Species Impacts?
			Lake Powell	Glen Canyon Dam to Lake Mead	Lake Mead	Hoover Dam to the SIB	Salton Sea	
Polished blazing star	*Mentzaelia laevicaulis*	BLM NV	—	—	X	—	—	No. This species grows in upland sandy and rocky habitat, which will not be impacted by any alternative.
Rainbow manzanita	*Arctostaphylos rainbowensis*	BLM CA	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.
Ramona horkelia	*Horkelia truncata*	BLM CA	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.
Reveal's buckwheat	*Eriogonum contiguum*	BLM CA	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.
Robinson's monardella	*Monardella robisonii*	BLM CA	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.
Rosy twotone beardtongue	*Penstemon bicolor* ssp. *roseus*	BLM NV	—	—	X	—	—	No. This species grows in upland habitat, which will not be impacted by any alternative.
Salt marsh bird's-beak	*Chloropyron maritimum ssp. maritimum*	BLM CA	—	—	—	X	—	No. This species grows in coastal salt marsh habitat, which will not be impacted by any alternative.
San Bernadino milk-vetch	*San Bernardino milk-vetch*	BLM CA	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.
San Diego goldenstar	*Bloomeria clevelandii*	BLM CA	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.

Common Name	Scientific Name	Listing Status	Location					Potential Species Impacts?
			Lake Powell	Glen Canyon Dam to Lake Mead	Lake Mead	Hoover Dam to the SIB	Salton Sea	
San Diego gumplant	*Grindelia hallii*	BLM CA	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.
San Diego milk-vetch	*Astragalus oocarpus*	BLM CA	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.
Sandfood	*Pholisma sonorae*	BLM AZ	—	X	X	X	—	No. This species grows in upland desert, which will not be impacted by any alternative.
San Jacinto mariposa-lily	*Calochortus palmeri var. munzii*	BLM CA	—	—	—	X	—	No. This species' range is outside of areas impacted by any alternatives.
San Luis Obispo sedge	*Carex obispoensis*	BLM CA	—	—	—	X	—	No. This species' range is outside of areas impacted by any alternatives.
San Miguel savory	*Clinopodium chandleri*	BLM CA	—	—	—	X	—	No. This species' range is outside of areas impacted by any alternatives.
Sanford's arrowhead	*Sagittaria sanfordii*	BLM CA	—	—	—	X	—	No. This species' range is outside of areas impacted by any alternatives.
Santa Lucia dwarf rush	*Juncus luciensis*	BLM CA	—	—	—	X	—	No. This species' range is outside of areas impacted by any alternatives.
Scaly sandplant	*Pholisma arenarium*	BLM AZ	—	X	X	X	—	No. This species grows in upland sand and dune habitat, which will not be impacted by any alternative.

Common Name	Scientific Name	Listing Status	Location					Potential Species Impacts?
			Lake Powell	Glen Canyon Dam to Lake Mead	Lake Mead	Hoover Dam to the SIB	Salton Sea	
Shevock's copper moss	*Mielichhoferia shevockii*	BLM CA	—	—	—	X	—	No. This species' range is outside of areas impacted by any alternatives.
Siler fishhook cactus	*Sclerocactus sileri*	BLM AZ	—	X	—	—	—	No. This species grows in upland desert, which will not be impacted by any alternative.
Silverleaf sunray	*Enceliopsis argophylla*	BLM AZ BLM NV	—	X	X	X	—	No. This species grows in upland desert, which will not be impacted by any alternative.
Small wirelettuce	*Stephanomeria exigua* ssp. *exigua*	BLM AZ	—	X	X	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.
Snake cholla	*Cylindropuntia californica var. californica*	BLM CA	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.
Spring Mountain milkvetch	*Astragalus remotus*	BLM NV	—	—	X	—	—	No. This species grows in upland talus and rocky slopes, which will not be impacted by any alternative.
Sticky buckwheat	*Eriogonum viscidulum*	BLM AZ BLM NV	—	—	X	—	—	Yes
Sticky dudleya	*Dudleya viscida*	BLM CA	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.
Sticky ringstem	*Anulocaulis leiosolenus*	BLM NV	—	—	X	—	—	No. This species grows in upland habitat, which will not be impacted by any alternative.

Common Name	Scientific Name	Listing Status	Location					Potential Species Impacts?
			Lake Powell	Glen Canyon Dam to Lake Mead	Lake Mead	Hoover Dam to the SIB	Salton Sea	
Summer holly	*Comarostaphylis diversifolia ssp. diversifolia*	BLM CA	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.
Tecate cypress	*Hesperocyparis forbesii*	BLM CA	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.
Tecate tarplant	*Deinandra floribunda*	BLM CA	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.
Threecorner milkvetch	*Astragalus geyeri* var. *triquetrus*	BLM NV	—	—	X	—	—	No. This species grows in upland sand and dune habitat, which will not be impacted by any alternative.
Tumamoc globeberry	*Tumamoca macdougalii*	BLM AZ	—	X	X	X	—	No. This species grows in upland desert, which will not be impacted by any alternative.
Variegated dudleya	*Dudleya variegata*	BLM CA	—	—	—	X	—	Yes
White bearpoppy	*Arctomecon merriamii*	BLM NV	—	—	X	—	—	No. This species grows in upland desert, which will not be impacted by any alternative.
Whitemargined beardtongue	*Penstemon albomarginatus*	BLM NV	—	—	X	—	—	No. This species grows in upland sand and dune habitat, which will not be impacted by any alternative.
White-bracted spineflower	*Chorizanthe xanti var. leucotheca*	BLM CA	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.

Common Name	Scientific Name	Listing Status	Location					Potential Species Impacts?
			Lake Powell	Glen Canyon Dam to Lake Mead	Lake Mead	Hoover Dam to the SIB	Salton Sea	
Wiggins' croton	*Croton wigginsii*	BLM CA	—	—	—	X	—	No. This species grows in upland sand and dune habitat, which will not be impacted by any alternative.
Yellow twotone beardtongue	*Penstemon bicolor* ssp. *bicolor*	BLM NV	—	—	X	—	—	No. This species grows in upland habitat, which will not be impacted by any alternative.
Yucaipa onion	*Allium marvinii*	BLM CA	—	—	—	X	—	No. This species grows in upland habitat, which will not be impacted by any alternative.

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Appendix H

Response to Public Comments

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Appendix H. Response to Public Comments

H.1 Introduction

This appendix describes the public comment process on the revised Draft Supplemental EIS (SEIS) and includes responses to public comments.

H.2 Original Draft SEIS Public Involvement and Comment Analysis

The Bureau of Reclamation (Reclamation) published a Notice of Availability of the Draft SEIS in the *Federal Register* on April 14, 2023. A 45-day scoping comment period was held from April 14, 2023, to May 30, 2023. On May 22, 2023, Reclamation temporarily withdrew the Draft SEIS so that it could fully analyze a new consensus-based system conservation proposal under the National Environmental Policy Act (NEPA). Once Reclamation withdrew the Draft SEIS, the original May 30, 2023, deadline for the submission of comments on the Draft SEIS was no longer in effect.

Reclamation informed interested parties of the Notice of Availability and public comment period through an email notification to the project mailing list (898 recipients) on April 19, 2023. The email notification consisted of the Notice of Availability and the dates for four public webinars. Four virtual public webinars were held during the public comment period.

Reclamation received 15,527 submittals during the public comment period from April 14–May 22, 2023, and additional substantive comments received through June 9, 2023. Approximately 4% of the submittals were unique letters, with the remainder being form letters and form letters with additional content. The majority (99.8%) of senders were individuals. From these submittals, 389 comments were identified. The common themes from the comments included general project inquiries, comments on Alternative 2, alternatives considered but eliminated from detailed analysis, water conservation and drought topics, other laws and regulations, socioeconomics and recreation, and Indian Trust Assets.

Reclamation considered and responded to all unique substantive public comments received and made changes to the Final SEIS as appropriate. Section 1.6 of the Final SEIS summarizes changes made since publication of the revised Draft SEIS. All public comments received are retained in the project's administrative record.

H.3 Revised Draft SEIS Public Involvement

On October 27, 2023, the Notice of Availability of the revised Draft SEIS was published in the *Federal Register*. The *Federal Register* notice also announced a 45-day public comment period ending on December 11, 2023, and two virtual public scoping webinars.

H.3.1 Advertising of the Notice of Availability and Public Meetings

Reclamation informed interested parties of the Notice of Availability through a press release on October 25, 2023, and email notification to the project mailing list (1,040 recipients) on October 27, 2023 (**Table H-1**).

Paper copies were made available for public review at the Lower Colorado Basin Regional Office, 500 Fir Street, Boulder City, Nevada 89005, and at the Upper Colorado Basin Regional Office, 125 South State Street, Room 8100, Salt Lake City, Utah 84138, as well as area offices within the Colorado River Basin.

Table H-1
Revised Draft SEIS Public Comment Period Notification Methods and Publication Dates

Notification Item	Method and Date
Press release	Reclamation News and Multimedia website,[1] October 25, 2023
Notice of Availability	*Federal Register*, October 27, 2023
Email notification	Project mailing list, October 27, 2023

Two virtual public webinars were held during the public comment period. **Table H-2** provides a summary of the dates, times, and meeting attendance of the webinars. The webinars consisted of an overview of the project background, an overview of the revised Draft SEIS, alternatives being considered in the SEIS, and an overview of the impacts analysis in the revised Draft SEIS. The webinars also included opportunities for the public to ask clarifying questions about the project. The webinars were recorded and published on the project website.[2]

Table H-2
Public Meeting Dates, Locations, and Attendance

Meeting Format	Meeting Date	Meeting Time	Number of Attendees
Virtual (Zoom) webinar	Thursday, November 9, 2023	5:30 p.m. to 7:00 p.m. Mountain Daylight Time	24
Virtual (Zoom) webinar	Friday, November 17, 2023	11:00 a.m. to 12:30 p.m. Mountain Daylight Time	57

[1] https://www.usbr.gov/newsroom/news-release/4660
[2] https://www.usbr.gov/ColoradoRiverBasin/interimguidelines/seis/publicinvolvement.html

H.3.2 Public Engagement Website

An interactive webpage with information on the project background and summaries of the revised Draft SEIS alternatives and analyses was made available for review during the public comment period. The webpage included summary tables of potential effects of the alternatives for seven of the issues analyzed in detail, a summary of the NEPA process, and a link to the comment webform. The interactive webpage was available in both English and Spanish.

H.3.3 Opportunities for Public Comments

Public comments were accepted during the comment period by email to CRinterimops@usbr.gov, by telephone message at (602) 609-6739, by webform on the project website at https://www.usbr.gov/ColoradoRiverBasin/interimguidelines/seis/publicinvolvement.html, verbally at the public meetings, and by mail to Reclamation 2007 Interim Guidelines SEIS Project Manager, Upper Colorado Basin Region, 125 South State Street, Suite 8100, Salt Lake City, Utah 84138.

H.4 Comment Collection and Analysis

H.4.1 Comment Processing

An electronic comment analysis and reporting database was used to manage the comment submittals. Comments received included unique submittals with unique content, one form letter submittal (submittals from multiple entities or individuals containing identical or similar content), and form plus submittals (letters that have additional unique content in addition to the form letter content).

Names, contact information, and letter text for all respondents were entered into the database. Each database entry was considered a "submittal" and assigned a unique number, and the sender type was captured to indicate the entity from which it was received (i.e., individual, government, Tribe, or organization). Submittals that included only a person's name and any address information were categorized as having been received from an individual. Comments from businesses were categorized as an organization. Submittals from elected officials were categorized as government or Tribe, depending on their affiliation. Submittals from water management agencies, water and irrigation districts, water service providers, and electric service providers were categorized as government submissions due to the governmental and quasi-governmental status of the senders (e.g., San Diego County Water Authority, Colorado River Water Conservation District, Salt River Project, etc.).

After the submittals were entered into the database, each unique submittal was read to identify specific comments. A coding structure was developed to help thematically sort comments in the database into logical topics that represent substantive issues and concerns for the Final SEIS. Outputs from the database consist of tallies of the total number of submittals and comments received, sorting and reporting comments by a topic or issue, and sender affiliations.

All public comments received are retained in the project's administrative record.

H.4.2 Substantive Comments

The comment analysis process is used to identify substantive public comments. Substantive comments formed the basis for much of the revision that occurred between publication of the revised Draft SEIS and the Final SEIS.

In general, substantive comments do one or more of the following:

- Question, with a reasoned basis related to the analysis, the accuracy of information in the revised Draft SEIS.
- Question, with a reasoned basis related to the analysis, the adequacy of, methodology for, or assumptions used for the analysis.
- Present new information relevant to the analysis.
- Present reasonable alternatives other than those analyzed in the revised Draft SEIS.
- Present issues for analysis other than those analyzed in the revised Draft SEIS.
- Cause changes or revisions in one or more of the alternatives.

H.5 Summary of Comment Submittals

Reclamation received 597 letter submissions (unique, form, form copy, form plus, and duplicate letters[3]) during the public scoping period. Of the 597 letters, 86 were unique letters, 18 were duplicate letters, 1 was a form letter, 480 were form copies, and 12 were form plus letters (**Table H-3**). **Table H-4** provides information on the affiliation of letter submissions and the number of senders. **Table H-5** lists the specific Tribes; federal, state, and local entities; and non-governmental organizations (NGOs) and stakeholders that submitted letters during the scoping period. Joint-entity submissions are also listed in **Table H-5**.

Table H-3
Submittals by Type

Type	Number of Submittals	Percentage of Total Submittals
Unique	86	14%
Duplicate	18	3%
Form	1	<1%
Form copy	480	81%
Form plus	12	2%
Total	**597**	**100%**

[3] Unique letters are submittals with unique content; form letters are submittals from multiple entities or individuals containing identical or similar content; form copy letters are submittals that have the same text as a form letter; form plus letters are submittals that have additional unique content in addition to the form letter content; duplicate submittals are duplicates of a unique letter.

Table H-4
Summary of Sender Affiliation Type

Affiliation	Number of Senders
Tribes	12
Federal, state, and local entities	42
NGOs and stakeholders	28
Individuals	536
Total	**618**

Note: The total number of senders (618) does not equal the total number of letter submittals (597), as more than one sender may be affiliated with a submittal.

Table H-5
Sender Affiliations

Tribes	
Colorado River Indian Tribes	San Luis Rey Indian Water Authority
Fort McDowell Yavapai Nation	Southern Ute Indian Tribe
Fort Yuma Quechan Indian Tribe	Jicarilla Apache Nation
Gila River Indian Community	Tohono O'odham Nation
Hualapai Tribe	Ute Indian Tribe of the Uintah and Ouray Reservation
Federal, State, and Local Entities	
Arizona Power Authority	Munger, Tolles & Olson LLP (Yuma-area irrigation districts)
Aurora Water	National Park Service
Bard Water District	North Gila Valley Irrigation and Drainage District
Board of Water Works of Pueblo, CA	Northern Water
California Department of Fish and Wildlife	Salt River Project
Central Utah Water Conservancy District	San Diego County Water Authority
City of Escondido and Vista Irrigation District	Southeastern Colorado Water Conservancy District
City of Tucson and Tucson Water	State of Nevada Colorado River Committee
City of Yuma	Twin Lakes Reservoir and Canal Company
Colorado River Water Conservation District	US Fish and Wildlife Service
Colorado Springs Utilities	Upper Colorado River Commission
Denver Water	Washington County Water Conservancy District
Environmental Protection Agency	Wellton-Mohawk Irrigation and Drainage District
Front Range Water Council	Western Area Power Administration
Imperial County Air Pollution Control District	Yuma Irrigation District
Imperial Irrigation District	Yuma Mesa Irrigation and Drainage District
Lower Division States (California, Arizona, Nevada)	
Mohave County Board of Supervisors	

Organizations	
American Whitewater	Leadership Counsel for Justice and Accountability
Amphibian Refuge	Living Rivers
Arizona Municipal Power Users' Association	National Parks Conservation Association
BlueRibbon Coalition	Natural Resource Defense Council
Colorado River Energy Distributors Association	Pacific Institute
Comite Civico del Valle	Returning Rapids Project
Geothermal Worldwide, Inc.	San Xavier Allottees Association
Glen Canyon Institute	Sierra Club Colorado River Task Force
Grand Canyon River Guides, Inc.	Sonoran Institute
Grand Canyon State Electric Cooperative Association	Stout Research Center
Grand Canyon Trust	Utah Rivers Council
Great Basin Water Network	Yuma County Water Users' Association
Irrigation and Electrical Districts' Authority Association of Arizona	
Joint Entity Submissions	
Joint Arizona Public Power Interests	Joint Local Water Agencies
Joint Irrigation Districts	Joint Organization

From the 597 letter submittals, 506 comments were identified (see **Section H.7**). **Table H-6** lists the coding structure themes, the number of comments coded to each theme, and the percentage of those codes out of the total comments. **Chapter 3** summarizes the comments for each comment theme.

Table H-6
Comment Coding Summary

Theme	Number of Comments	Percentage of Total Comments
Hydrology	38	7.5%
Policy and legal compliance	37	7.3%
Alternatives not analyzed in detail	36	7.1%
Salton Sea	31	6.1%
Proposed Action Alternative	27	5.2%
Support project	26	5.0%
Scope of analysis	24	4.6%
Aquatic wildlife	22	4.2%
Modeling	18	3.6%
Vegetation and noxious weeds	18	3.6%
Socioeconomics	15	3.0%
Indian Trust Assets	13	2.6%
Editorial	12	2.4%
Electrical power	12	2.4%
Water quality	12	2.4%
Environmental justice	11	2.2%

Theme	Number of Comments	Percentage of Total Comments
Mitigation	10	2.0%
Consultation and coordination (biology)	9	1.8%
Cooperation and coordination (cultural resources)	9	1.8%
Water deliveries to Lower Division States	9	1.8%
Terrestrial wildlife	9	1.8%
Air quality, climate change, and greenhouse gases	8	1.6%
Attention needed	8	1.6%
Human health and safety	8	1.6%
NEPA process	8	1.6%
Recreation	8	1.6%
Purpose and need	7	1.4%
Water conservation drought	7	1.4%
Cooperating agencies	6	1.2%
Long-term Experimental and Management Plan	6	1.2%
Cumulative effects	5	1%
Post-2026 guidelines	5	1%
No Action Alternative	4	0.8%
April Draft SEIS	4	0.8%
Cultural resources	4	0.8%
Out of scope	4	0.8%
Public and stakeholder involvement	4	0.8%
Data sources	3	0.6%
Issues not considered in detail	2	0.4%
Paleontology	2	0.4%
Water deliveries to Upper Division States	2	0.4%
Visual resources	2	0.4%
Water deliveries to Mexico	1	0.2%
Total	**506**	**100%**

H.6 Public Comment Themes and Responses

Several common themes were identified during review of the public comments. This section summarizes the common themes and provides general responses to those themes.

H.6.1 Indian Trust Assets and Environmental Justice

Theme: Commenters requested that the US Government fulfill its trust responsibility to Tribes, resolve water rights for the 12 Tribes whose water rights remain unsettled, and find ways to provide safe water to all Tribal members. Concerns about the revised Draft SEIS include that the document contains an insufficient articulation and definition of Indian water rights, the rights of Tribes, and the role of the federal government as trustee of these Tribal trust assets. Comments stated that it is Reclamation's responsibility to ensure that water settlement assets are available in the future and that Tribes are treated equitably with respect to equitable Indian Trust Assets. Comments stated that

reductions in Colorado River water deliveries need to be accomplished without reducing the amounts of water allocated to Tribes in congressionally approved water settlements, absent Tribal consent to such reductions, and that Reclamation should ensure that all reductions to Tribal statutory water entitlements are voluntary and compensated or replaced. Additional environmental justice concerns include not addressing impacts to Colorado River Storage Project customers outside the Colorado River Basin. Comments stated that impacts from the Proposed Action should be assessed not only for the Tribes from a water delivery standpoint, but also from a hydropower impact standpoint for all 52 Tribes that are now Colorado River Storage Project firm electric service customers.

Response: Reclamation continues to work on settling Tribal water rights. Reclamation is committed to the discussion of Tribal water rights with individual Tribes, which is beyond the short time frame covered by this SEIS. Consultation is ongoing. The SEIS concerns operations at Lake Powell and Lake Mead. The Tribes have a variety of water rights across the Basin, with unique characteristics. A detailed discussion of these rights is not required unless it is related to operations within the scope of the SEIS. Some Tribes may choose to participate in the voluntary system conservation opportunities described in the Proposed Action. Such participation is voluntary and does not affect any Tribe that does not want to voluntarily participate. The voluntary conservation would also increase reservoir levels, compared with the No Action Alternative, making mandatory shortages less likely under the 2007 Interim Guidelines. The likelihood of additional involuntary shortages is low, and Reclamation would not impose additional involuntary shortages without appropriate coordination and consultation. The analysis in the SEIS does not modify any entitlement or applicable statutory, settlement, or contract terms.

This SEIS concerns annual release volumes from Glen Canyon Dam and does not propose changes to hydropower operations for the Colorado River Storage Project reservoir system across the Basin. The Colorado River Storage Project power units across the Basin and the need to maintain the Upper Colorado River Basin Fund are outside the scope of this SEIS. Reclamation realizes that annual release volumes affect hydropower production and Upper Colorado River Basin Fund matters, but modifying annual releases for the purpose of affecting hydropower production is outside the scope of this analysis. Appendix K of the Final LTEMP EIS analyzes environmental justice impacts and impacts on Tribal customers. Chapter 3 of the LTEMP EIS provides analysis of hydropower and marketing.

H.6.2 Water Modeling

Theme: Commenters are concerned that the modeling results used in the revised Draft SEIS impact analysis are not based on current reservoir conditions and are based on the improved hydrology of operating year 2023. Commenters requested that the models and impact analysis be updated using updated/current hydrology and measurable levels of Lake Powell and Lake Mead. Comments specifically requested that Reclamation wait until the end of the first quarter of 2024 to use more accurate data on which to base a final decision.

Response: Reclamation recognizes that the hydrology has declined since the modeling was redone based on June 2023 numbers, but it is still within the range shown in the graph from the Final SEIS Dear Reader Letter (see new figure). Delaying the analysis until the end of the first quarter of 2024

would delay the Record of Decision (ROD), would not allow Reclamation to have necessary operational tools in place to operate Lake Powell to adequately address potential low-flow conditions in operating year 2024, and would divert attention away from the Basin's efforts to address post-2026 operations.

H.6.3 Range of Alternatives

Theme: Commenters expressed concern about the range of alternatives in the revised Draft SEIS, including the analysis of only the Proposed Action and No Action and removing analysis of Action Alternatives 1 and 2 from the original Draft SEIS. Commenters also requested that Reclamation analyze a resource protection alternative that acknowledges its obligations under the Grand Canyon Protection Act, Executive Order 12114, and the Endangered Species Act, as well as other laws and Native American rights.

Response: The range of alternatives analyzed in this SEIS is reasonable. Action Alternatives 1 and 2 were considered in the original Draft SEIS but were ultimately dismissed from detailed analysis in the revised Draft SEIS because their performance was similar to or worse than the Lower Division proposal (now the Proposed Action), as explained in the Dear Reader Letter and Section 2.8. As explained in the Dear Reader Letter of the revised Draft SEIS, Reclamation analyzed the Lower Division Proposal (now the Proposed Action) at the request of the seven Basin States, and that analysis shows that the Proposed Action balances the risk between Lake Mead and Lake Powell better than the alternatives considered in the original Draft SEIS. The current range of alternatives thus meets the purpose and need to address low reservoir conditions across the Basin in the short term and, perhaps more importantly, provides the space "so that all parties can focus their resources on the development of the post-2026 guidelines," as described by the seven Basin States.

Comments received during scoping asked Reclamation to design an alternative that maintains Colorado River flows and supports ecosystem needs; however, the Proposed Action meets all obligations under the Grand Canyon Protection Act, Executive Order 12114 (through incorporating Minute 323), and the Endangered Species Act. The Grand Canyon Protection Act applies more to the timing of sub-annual flows, whereas this SEIS considers changes to annual flows. The implications for more particular sub-annual releases are described in Section 2.7.2. The Biological Assessment currently prepared for this SEIS analyzes reduced deliveries up to 2.5 million acre-feet (maf) annually in total. This SEIS analysis extends to the Southerly International Boundary with the United Mexican States (Mexico). As described in Section 2.8.6, an ecosystem-based alternative does not meet the federal action's purpose, need, or objectives. This is because it does not focus on the critically low elevations impacting the operations of both Glen Canyon and Hoover Dams during the interim period, which expires at the end of 2026.

H.6.4 Proposed Action

Theme: Commenters are concerned that despite recent wet conditions, it is likely that there will be continued decreases in the available water supply throughout the Basin and that therefore the steps outlined in the Proposed Action will not be adequate. Other concerns included that the Proposed Action relies on speculative conservation efforts and does not provide adequate measures to protect Lake Powell if hydrology is similar to the 2021–2022 conditions. Commenters requested that the

Proposed Action include specific provisions to protect critical elevations at Lake Powell, similar to the previously proposed Action Alternatives 1 and 2.

Response: Analysis of the Proposed Action was supported by the seven Basin States, and the analysis showed that the Proposed Action balances the risks between Lake Powell and Lake Mead better than the Operational Tiers considered in Action Alternatives 1 and 2, as demonstrated in the graph on page 2 of the Dear Reader Letter. Action Alternatives 1 and 2 were therefore moved to the Alternatives Considered but Eliminated from Detailed Analysis section.

The SEIS conservation efforts are not speculative. Conservation agreements have either been executed or are reasonably foreseeable. As of December 2023, Reclamation has executed contracts for approximately 1.55 maf of system conservation water and is actively working on additional system conservation agreements to be signed in 2024, which could add approximately 800,000 acre-feet (af) through 2026. The Lower Division States and their partners may also enter agreements to implement SEIS conservation and need to be given this flexibility. For example, the Lower Division States have targeted approximately 600,000 additional af of conserved water in 2023 that would count as SEIS conservation as described in the revised Draft SEIS.

Reclamation has a strong partnership with the seven Basin States, water users, Tribes, and Mexico, and we expect that to continue. This partnership has, among other things, resulted in conservation activities that have added approximately 5.1 maf to Lake Mead between 2007 and 2022. These types of agreements and partnerships have been effective, and Reclamation will continue to use them to meet water conservation targets for the duration of the interim period, which expires at the end of 2026.

Under the Proposed Action, Reclamation would have the ability to reduce Lake Powell's releases to 6.0 maf, in addition to the Secretary of the Interior's ongoing reserved authority to take emergency actions in order to protect critical infrastructure.

H.6.5 Compliance with LTEMP

Theme: Commenters stated that LTEMP dictates dam operations through monthly, daily, and hourly releases from Glen Canyon Dam and that the LTEMP ROD relied on modeling and analysis of minimum annual releases of 7.0 maf from Glen Canyon Dam. Because the Proposed Action Alternative in the revised Draft SEIS considers a 6.0 maf annual release from Glen Canyon Dam, commenters question how Reclamation could operate a 6.0 maf annual release "while maintaining LTEMP minimum flows" and being "consistent with the LTEMP ROD," when those flows were determined based on a minimum 7.0 maf annual release.

Response: As described in Section 2.7.2, hourly and daily releases would follow LTEMP parameters, as long as sufficient water is available from the annual release. If sufficient water is not available from the annual release to meet hourly and daily LTEMP release parameters, hourly and daily releases would follow the base operation daily and nightly minimum flows (8,000 cubic feet per second [cfs] and 5,000 cfs, respectively) for as long as possible. If sufficient water is not available from the annual release to support the base operation nightly minimum flow of 5,000 cfs, hourly

and daily releases would be consistent with the run of the river to match Lake Powell inflows, consistent with protecting an elevation of 3,500 feet at Lake Powell, when possible.

H.6.6 Scope of Impact Analysis

Theme: Comments regarding the scope of the revised Draft SEIS analysis include concerns about not analyzing impacts on water and power users outside the Lower Basin. Some specific concerns included not analyzing impacts to Tribes in the Upper Basin, Mexico's plans for Colorado River water, and not analyzing impacts in areas that are outside the Basin but receive Colorado River water.

Response: This SEIS analyzes impacts at the point of delivery within the Lower Basin. Impacts beyond this point are too speculative to include for the short-term operations proposed in this NEPA analysis. Where specific resources are affected outside the defined geographic scope and those effects are capable of being meaningfully analyzed, expanded analysis areas are defined in the applicable section of Chapter 3 of the SEIS.

H.6.7 Salton Sea

Theme: Commenters expressed concern that the Proposed Action would have injurious effects on the Salton Sea, including its wildlife and the people who live and work in areas adjacent to the lake, including Tribes and other environmental justice communities. Concerns included that the revised Draft SEIS does not adequately discuss significant negative impacts on the Salton Sea and does not propose mitigation measures to minimize the impacts; that the conclusions drawn regarding adverse impacts related to the Salton Sea are deficient; and that the mitigation measures suggested for addressing the negative effects are inadequate and speculative and will be ineffective. Comments also included concerns about past and ongoing management of the Salton Sea by various government agencies.

Response: Impacts on the Salton Sea are described under cumulative effects, as Reclamation analyzes impacts at the point of delivery. Site-specific impacts from shoreline exposure at the Salton Sea are being analyzed in the US Army Corps of Engineers' separate environmental assessment and in the environmental assessment for the Imperial Irrigation District SEIS conservation. Any mitigation is appropriately addressed through these other NEPA processes. Separate actions at the Salton Sea to address biological and public health issues are ongoing. The Salton Sea Management Program Phase 1: 10-Year Plan (2018–2028) identifies a goal to create 29,800 acres of aquatic habitat and dust suppression projects to improve conditions around the Salton Sea. To assist in implementation of the Salton Sea Management Program, in December 2022, the Department of the Interior authorized $250,000,000 to support and expedite the implementation of projects at the Salton Sea. This funding will expand the Species Conservation Habitat Project, adding up to 7,000 acres of aquatic restoration to the 4,100 acres already constructed at the project site. Please refer to the 2023 California Natural Resources Agency Annual Report on the Salton Sea Management Program for more information related to ongoing efforts and prior year accomplishments.

H.6.8 Evaporation and Seepage

Theme: Commenters requested that the revised Draft SEIS analysis account for evaporation and system losses in all seven Basin States. Commenters asked that the analysis take into account

evaporation, leakage, and other losses throughout the system to more accurately assess potential impacts and to more equitably and sustainably allocate Colorado River resources, including accounting for estimated losses. Comments requested that Reclamation assess the comparative loss of water from infiltration and evaporation between maintaining both reservoirs, maintaining only Lake Mead, and an alternative where Lake Powell is kept low to reduce losses to infiltration and evaporation. Comments inquired about the informational report from Reclamation, which addresses potential methodologies to support assessments for evaporation and other system losses; commenters requested that this information be included in the impact analysis.

Response: Evaporation and system losses are outside the scope of this SEIS. For more information on this issue, see the report published by Reclamation in early 2024. The report presents methodologies that have been used to develop those data sets; however, it does not make recommendations about how to implement or account for system losses from the Lower Colorado River mainstream.

H.6.9 Role of Mitigation

Theme: Commenters expressed concern that the document does not propose mitigation for adverse impacts on the natural and human environment, including environmental justice communities, socioeconomic impacts, impacts on Indian Trust Assets, and hydropower impacts. Commenters stated that mitigation needs to be conducted simultaneously with the actions proposed.

Response: The purpose of Reclamation's Proposed Action is to mitigate impacts from ongoing trends in the Colorado River System. Continuing with current operations through 2026 would likely result in adverse effects on environmental justice communities, socioeconomics, and Indian Trust Assets. The Proposed Action involves voluntary actions to conserve Colorado River water for which no mitigation is required. Entities wishing to participate in conservation under the Proposed Action do so voluntarily and are compensated for their participation. There are limited resources for which mitigation might be appropriate in the case of the actions considered in this SEIS. Biological mitigation measures will be identified in the Biological Opinions issued by the US Fish and Wildlife Service related to this SEIS.

H.7 Public Comments and Responses

Table H-7 include all letter submittal number and sender information. **Table H-8** includes all substantive comments identified during the comment analysis process and provides responses to the comments.

Table H-7
Submittal Letter Number and Sender

Letter Number	Organization	Sender Name
4	Grand Canyon Trust	Jen Pelz
9	Munger, Tolles & Olson LLP (Yuma-area irrigation districts)	Benjamin Horwich
11	—	John Coffee
12	Munger, Tolles & Olson LLP (Yuma-area irrigation districts)	Benjamin Horwich
15	—	Carol Beckman
49	—	rob roblasvegas.com
56	Geothermal Worldwide, Inc.	Nikola Lakic
109	Fort McDowell Yavapai Nation	Gerry Walker
115	Ute Indian Tribe of the Uintah and Ouray Reservation	Joanne Curry
116	The Jicarilla Apache Nation	Edward Velarde; Jenny Dumas
117	National Park Service	Katharine Hammond
120	—	Lois Denaut
124	Amphibian Refuge	Eric Johnson
127	—	John Coffee
128	—	Logan Robinson
138	BlueRibbon Coalition; BlueRibbon Coalition	Simone Griffin; Ben Burr
150	—	David McCune
222	San Xavier Allottees Association; San Xavier Allottees Association	Ben Standifer; Lucinda Nunez
282	Western Area Power Administration	Derek Fryer
283	Grand Canyon River Guides, Inc.	Lynn Hamilton
284	Munger, Tolles & Olson LLP (Yuma-area irrigation districts); Wellton-Mohawk Irrigation and Drainage District; Yuma Mesa Irrigation and Drainage District; Yuma Irrigation District; North Gila Valley Irrigation and Drainage District	Benjamin Horwich; Robbie Woodhouse; James Weddle; Mark Smith; Larry Ott
285	Pacific Institute; Leadership Counsel for Justice and Accountability	Michael Cohen; Nataly Escobedo Garcia
287	—	Jasmyn Phillips
288	Grand Canyon Trust	Jen Pelz
289	Comite Civico del Valle	Adrinna Teran; Jordan Sisson
290	Geothermal Worldwide, Inc.	Nikola Lakic
292	State of Nevada; State of Arizona; State of California	John Entsminger; Thomas Buschatzke; J.B. Hamby
294	Denver Water; Front Range Water Council; Southeastern Colorado Water Conservancy District; Board of Water Works of Pueblo, CA; Twin Lakes Reservoir and Canal Company; Colorado Springs Utilities; Northern Water; Aurora Water	Alan Salazar; Front Range Water Council; James Broderick; Seth Clayton; Alan Ward; Lisa Barbato; Bradley Wind; Marshall Brown

Letter Number	Organization	Sender Name
295	Natural Resource Defense Council; Natural Resource Defense Council	Mark Gold; Edward Osann
296	Colorado River Indian Tribes	Amelia Flores
297	Glen Canyon Institute; Living Rivers; Returning Rapids Project; Utah Rivers Council; Great Basin Water Network; National Parks Conservation Association	Eric Balken; John Weisheit; Mike DeHoff; Zach Frankel; Kyle Roerink; Ernie Atencio
298	Salt River Project	Leslie Meyers
299	San Diego County Water Authority	Dan Denham
300	Colorado River District	Andrew Mueller
301	Colorado River Committee - State of Nevada	Eric Witkoski
302	Living Rivers	John Weisheit
305	Washington County Water Conservancy District	Morgan Drake
306	—	Larry Stevens
308	Mohave County Board of Supervisors	Toni Flora
310	Sierra Club	Cary Meister
314	American Whitewater	Kestrel Kunz
317	City of Yuma	Jeremy McCall
319	Quechan Indian Tribe	Jay Weiner
320	Gila River Indian Community	Stephen Lewis
324	—	Russell Riggs
326	U.S. Fish and Wildlife Service	Williams, Deborah
340	San Luis Rey Indian Water Authority	Bonnie Mazzetti
343	—	Carol Stines
350	—	Gregory H
353	—	Steve Hinkemeyer
365	Yuma County Water Users' Association	James Auza
370	—	Chuck Parker
380	Environmental Protection Agency	Truitt, Robin
410	Tohono O'odham Nation	Howard Shanker
484	Upper Colorado River Commission	Chuck Cullom; Alyx Richards
539	Bard Water District; Bard Water District	Ray Face; Nick Bahr
548	Colorado River Energy Distributors Association	Leslie James
550	Sonoran Institute	Richard Schaefer
553	City of Escondido; Vista Irrigation District	Christopher McKinney; Brett Hodgkiss
555	Arizona Municipal Power Users' Association; Grand Canyon State Electric Cooperative Association; Arizona Power Authority; Irrigation and Electrical Districts' Authority Association of Arizona	Russell Smoldon; Dave Lock; Jordy Fuentes; Ed Gerak
556	Southern Ute Indian Tribe	Lorelei Cloud
557	Stout Research Center	Jenny E. Ross
562	City of Tuscon, Tuscon Water	John Kmiec
619	Hualapai Tribe	Sherry Parker
636	Imperial Irrigation District	Tina Shields

Table H-8
Substantive Comments and Responses

Letter Number	Letter Comment Number	Comment Code	Comment Text	Response
284	8	AIRCCGHG - Air Quality, Climate Change, Greenhouse Gases	The Districts urge the Bureau to correct errors in how the RDSEIS analyzes impacts of particular concern to the Yuma area. First, in its analysis of impacts to air quality, the RDSEIS models only fugitive shoreline dust near the reservoirs. RDSEIS at 2-27, 3-126. But it also recognizes, correctly, that imposing fallowing programs upon agricultural areas impacts air quality. See id. at 3-147. Thus, prior to taking any action that would result in involuntary fallowing in an agricultural community, the Bureau must satisfy NEPA by undertaking an analysis of the air quality impacts of such a program. See 40 C.F.R. SS 1508.1(g)(2) (an EIS or SEIS must discuss any reasonably foreseeable "effects related to induced changes in the pattern of land use . . . and related effects on air . . ."). This analysis is especially important for Yuma County because much of the area is already a designated PM-10 non-attainment area. See https://azdeq.gov/yuma-particulatematter- pm-10-nonattainment-area (accessed December 4, 2023).	Thank you for your comment. Neither the Proposed Action nor the No Action Alternative impose additional involuntary fallowing, but this SEIS does not preclude additional analysis as appropriate.
380	3	AIRCCGHG - Air Quality, Climate Change, Greenhouse Gases	considering mitigation measures to address potential air quality problems in the Salton Sea region from dust that could arise from decreased water deliveries to the Imperial and Coachella Irrigation Districts, if left unaddressed. The Draft SEIS acknowledges that Riverside and Imperial Counties are currently designated as nonattainment areas for the federal and state ozone (O3) and particulate material (PM2.5) standards and Imperial County is in maintenance for the state PM10 standard (p. 3-128). Blowing dust, that has concentrated waste and agricultural runoff, not only affects the ability to meet air quality standards but also affects the respiratory health of people throughout the Coachella and Imperial Valleys, many of whom reside in disadvantaged or border communities with environmental justice concerns (pgs. 3-131, 3-327; Maps 3-3 and 3-5). [see comment letter below for narrative]	There are no mitigation measures at this time proposed. This SEIS analyzes impacts at the point of delivery. Actions considered in this SEIS are not the main drivers of change in Salton Sea exposed lakebed. There are many sources of dust emissions in the Imperial Valley, and Reclamation acknowledges that the Salton Sea is one of them. This SEIS is analyzing a short timeframe of the remainder of the interim period, through 2026. The SEIS Proposed Action and the No Action Alternative would result in the same level of lakebed exposure; the alternatives only vary in the rate of exposure. Impacts and mitigation measures related to the comment are being analyzed in separate NEPA efforts such as the USACE Salton Sea Management Program Phase I: 10-Year Plan EA and the IID 2024-2026 Temporary Colorado River System Water Conservation Project.
484	17	AIRCCGHG - Air Quality, Climate Change, Greenhouse Gases	Air Quality This seems to be a very inadequate analysis of potential changes to air quality if IID and CVWD take additional shortages under the Proposed Action. Increased dust could have impacts to human health and Environmental Justice populations. The SEIS acknowledges the expedited exposure of the Salton Sea lake bed under the Proposed Action (pg 3-146), up to 40,224 acres of lake bed could be exposed through 2026 (pg 3-147), so the complete impacts of this should be analyzed and presented in this SEIS.	The SEIS analyzes effects at the point of delivery. This is an indirect impact analyzed in the SEIS. As noted in 3.9.2 SEIS section, the exposure would happen faster under the Proposed Action, but the exposure would happen eventually regardless. Site-specific effects are being analyzed through separate NEPA processes.

Letter Number	Letter Comment Number	Comment Code	Comment Text	Response
548	7	AIRCCGHG - Air Quality, Climate Change, Greenhouse Gases	3.9 AIR QUALITY/3.9.2 ENVIRONMENTAL CONSEQUENCES (3-128): Please consider revising reference to the "Upper Colorado River Basin" to the "Colorado River Storage Project". Reference to the Upper Basin only does not accurately capture the fact that CRSP generation (with Glen Canyon Dam as the largest generation resource) is marketed and distributed through both Upper and Lower Colorado River Basins, and replacement power resources are not just limited to the Upper Basin. (3-134): CREDA recommends the sentence subjectively describing the quantity of GHG emissions be revised to state clearly that there would be an increase in GHG emissions, which exacerbate climate-related impacts. It is unnecessary to subjectively describe the contribution in narrative terms, or to refer to GHG emission sources "around the world". The data in Table 3-23 is sufficient. The stand-alone paragraph referencing Lake Powell potential reservoir surfaces and GHG should be deleted as it is "uncertain" and "unquantified". (3-136): The paragraph describing HFE impacts to air quality is incorrect in that it states, "no additional impacts would occur at any downstream powerplants"; and that "These impacts would not be outside the range analyzed in LTEMP". Given that the LTEMP SEIS is currently in scoping, these statements should be deleted. In addition, "Any reduction would be offset by the purchase of replacement power" does not appear to relate to air quality analysis and should be clarified or removed.	The "Upper Colorado River Basin" is no longer in the Air Quality section. There are statements such as "The Glen Canyon Powerplant accounts for approximately 75 percent of the Upper Colorado Basin's annual energy production (Reclamation 2007). " and discussion of both the Upper and Lower Basins. The paragraph "Albeit a small contribution, this project-related increase in emissions, in combination with a variety of GHG emission sources around the world, could exacerbate climate-related impacts." will remain but will be updated to "Albeit a small contribution, this project-related increase in emissions, in combination with a variety of global GHG emission sources, could exacerbate climate-related impacts." GHG and climate change are global issues, therefore this statement is true. "Reservoir surfaces (and their drawdown areas) also can be potent emitters of GHGs. A preliminary survey at Lake Powell suggests relatively low surface water emissions (Waldo et al 2021 but the role of drawdown emissions from deltaic sediments may be significant when water levels drop (see Malenda et al. 2020). Due to uncertainty, these GHG emissions have not been quantified." This paragraph will remain, to let the reader know the latest information from a preliminary study and confirming that there has been no further studies or emission calculations. The statement "Any reduction would be offset by the purchase of replacement power." will be removed. The statement will be modified to "HFEs at different times of year could result in some impacts on generation. These impacts would not be outside the range analyzed in LTEMP. However, annual volume releases from Lake Powell are not anticipated to change under the LTEMP SEIS; therefore, no additional impacts are anticipated at any downstream powerplants."
557	8	AIRCCGHG - Air Quality, Climate Change, Greenhouse Gases	Use of the foregoing statements relating to the SSRREI and Perimeter Lake concepts indicates that the personnel responsible for preparing the portion of the Revised Draft SEIS related to Salton Sea issues lacked the necessary knowledge to analyze the pertinent matters appropriately. The SSRREI was proposed by IID and Imperial County in 2015 and was never acted upon. The "Perimeter Lake" concept was originally proposed many years ago, and never advanced toward implementation. Over the years various revised iterations of the "Perimeter Lake" concept, and some elements of the SSRREI, have been suggested repeatedly as long-term restoration options, but none of the proposals has been approved as a final plan to be constructed. Multiple substantially modified versions of the "Perimeter Lake" concept are currently being considered, along with numerous other possible long-term restoration alternatives, in the "Imperial Streams Salton Sea and Tributaries Feasibility Study" currently being conducted by the Army Corps of Engineers. No details of the current status of that study are publicly available. At this point it is not clear whether any comprehensive long-term restoration plan for the Salton Sea will ultimately be approved, funded, constructed, and operated successfully. It is misguided and unreasonable for the Revised Draft SEIS to present obsolete, unjustified, and irrelevant information relating to superseded long-term restoration concepts in order to make unwarranted claims about the magnitude of exposed Salton Sea lakebed and hazardous dust emissions that could result from the No Action Alternative and Proposed Action for near-term Colorado River operations. [See comment letter for additional details]	Modified the SEIS to include the year the SSREI and Perimeter Lake year and the current status as follows. "Projected exposed playa at the Salton Sea for both the Salton Sea Restoration and Renewable Energy Initiative (SSRREI) and Perimeter Lake alternatives show exposed playa will continue to increase as elevation decreases through 2047 and then stabilize. The SSRREI and Perimeter Lake alternatives were concepts proposed as early as 2015 and the long term restoration options included in these concepts have not yet been approved into final plan. Total exposed playa in all alternatives is projected to approach 100,000 acres by around 2047 and stabilize consistent with the elevation results. The mean elevation in 2018 was 20,549; in 2047, the mean elevation is projected to be 100,303 acres. The SSRREI alternative gradually converts some newly exposed playa into wetland habitat. The Perimeter Lake alternative covers some of the exposed playa when the lake levees are completed. Both alternatives have similar final exposed playa areas at build-out, and are similar to the No Action Alternative in terms of total playa area that may need to be managed for air quality impacts."

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557	9	AIRCCGHG - Air Quality, Climate Change, Greenhouse Gases	Under the heading "Cumulative Effects," the Revised Draft SEIS then asserts that "no additive cumulative effects would occur on air quality due to the proposed management plan evaluated in the Salton Sea 10- Year Plan or the environmental assessment for the implementation of the 10-Year Plan's projects."33 Again, this statement is unwarranted, and is based on false assumptions. As explained earlier, despite the fact that a draft 10-Year Plan was first issued by the Salton Sea Management Program in 2017, and notwithstanding the existence of legal requirements mandating that annual habitat restoration and dust suppression milestones must be achieved by the SSMP each year from 2018 through 2028 during the life of the 10-Year Plan, as of December 2023 there is no publicly-available final EA for the 10-Year Plan; there is still no final, approved, and funded 10-Year Plan; the required milestones have not been achieved in any year; and air quality in the Salton Sea region continues to deteriorate harmfully as increasing areas of exposed lakebed emit hazardous particulates. It has not even been publicly disclosed which proposed projects will be included in the final 10- Year Plan; and it is entirely uncertain which projects will actually be implemented in the future, or when such implementation will occur. The funding for proposed projects has not been obtained, the water supply required for their operation is not assured, and other necessary preconditions for constructing proposed projects have not been satisfied. Even if some projects are ultimately constructed, it is unknown whether they can operate successfully as intended. Based on the extremely slow pace of work done so far by the SSMP, with not a single habitat project proposed in the 2017 draft 10-Year Plan actually operating at the beginning of December 2023, it is exceedingly unrealistic and completely unjustified to claim that any 10-Year Plan project will be fully functional and will prevent cumulative effects on air quality during the period relevant to the Revised Draft SEIS.34 It is unreasonable for the Revised Draft SEIS to rely on unsupported speculation; and it is improper for Reclamation to use that unfounded speculation to draw the inaccurate conclusion that the Proposed Action will cause no cumulative negative effects on air quality and therefore, implicitly, will cause no harm to public health or other adverse impacts from impaired air quality.	Reclamation is using best available information for this analysis. This SEIS states that the proposed action could expedite impacts to the Salton Sea, but not cause additional impacts when compared to the No Action Alternative. This SEIS analyzes impacts at the point of delivery, therefore, impacts to the Salton Sea have been described under cumulative effects.

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557	10	AIRCCGHG - Air Quality, Climate Change, Greenhouse Gases	In the "Air Quality" section of the Revised Draft SEIS the text correctly states that "impact indicators" for air quality include greenhouse gas (GHG) emissions. However, the only GHG emissions discussed in the text are ones "from alternative power sources (coal and natural gas) due to reduced hydropower."35 In contravention of applicable legal requirements, significant GHG emissions resulting from exposure of the Salton Sea's lakebed and deterioration of its ecosystem due to freshwater deprivation are not considered at all in the Revised Draft SEIS, nor are the major social costs of those GHG emissions.36 Federal guidance applicable to NEPA analyses explicitly requires that agencies "must disclose and consider... the extent to which a proposed action and its reasonable alternatives (including the no action alternative) would result in reasonably foreseeable GHG emissions that contribute to climate change."37 Moreover, applicable federal guidance states that an agency's NEPA analysis should quantify a proposed action's projected GHG emissions...for the expected lifetime of the action," and "provide additional context for GHG emissions, including through the use of the best available social cost of GHG (SC-GHG) estimates, to translate climate impacts into the more accessible metric of dollars, allow decision makers and the public to make comparisons, help evaluate the significance of an action's climate change effects, and better understand the tradeoffs associated with an action and its alternatives..."38 The Revised Draft SEIS fails to include any such analyses for the significant biogenic GHG emissions, and their large social costs, that will foreseeably result from the effects of the Proposed Action and the No Action Alternative on the Salton Sea and its ecosystem. Nonetheless, the Revised Draft SEIS inaccurately indicates- using the same inappropriate boilerplate language employed repeatedly throughout the text to shrug off the possibility of "Cumulative Effects" on the Salton Sea, its wildlife, the environment, and people throughout the adjacent region- that no adverse impacts related to GHG emissions will occur at the Salton Sea "due to the proposed management plan evaluated in the Salton Sea 10-Year Plan or the environmental assessment for the implementation of the 10-Year Plan's projects."39 This claim is unsupported and erroneous. Not only will the proposed 10-Year Plan projects fail to counteract the GHG emissions from exposed lakebed and the deteriorating Salton Sea that foreseeably could result from the Revised Draft SEIS's Proposed Action, the 10-Year Plan's projects themselves could cause ongoing releases of significant quantities of GHGs,40 and those unmitigated GHGs would also result in large social costs.	Reclamation is using best available information for this analysis. This SEIS states that the proposed action could expedite impacts to the Salton Sea, but not cause additional impacts when compared to the No Action Alternative.

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222	1	ALTNO - No Action Alternative	The San Xavier Allottees Association opposes the BOR's adoption of the Proposed Action and supports the No Action Alternative because the Proposed Action will increase the risk to the San Xavier District of shortages in its entitlement of SAWRSA CAP Water. The Proposed Alternative will allow the BOR to reduce annual deliveries of water to the Lower Basin from the current (No Action Alternative) lower limit of 7.0 MAF to a lower limit of 6.0 MAF to keep the elevation of Lake Powell above 3,490' for power generation purposes. The BOR's analysis of various hydrologic scenarios for the 2024-26 period shows relatively little improvement in the risk of Lake Powell falling below the 3,400' elevation as between the Proposed Action and the No Action Alternative, and a probability of substantially higher economic value of power generation under the No Action Alternative. We suggest that the BOR adopt the No Action Alternative and implement the provisions of the first 8 items in the Lower Basin's May 22, 2023, letter independently. Implementation of the first 8 paragraphs in the Lower Basin's proposal should not be conditioned upon the adoption of paragraph 9 because paragraph 9 does not benefit the Lower Basin, only the BOR by slightly lessening the risk that Lake Powell will drop below the 3,500' elevation and minimum power pool at 3,490' elevation. The Lower Basin should be expected to implement its proposed compensated and uncompensated conservation of 3.0 MAF during the period 2024-26 given the availability of federal funds to compensate up to 2.5 MAF of conservation and given the Secretary's previously announced call to Lower Basin users to reduce annual use by 2-4 MAF. This will significantly reduce the risk of water supply shortages in the Lower Basin, whereas implementation of paragraph 9 of the Lower Basin's letter proposal will have the opposite effect.	Under the Proposed Action, tier-based reductions and contributions would be limited to the existing 2007 Interim Guidelines, Lower Basin DCP, and Minute 323. Glen Canyon Dam operations would remain consistent with the existing 2007 Interim Guidelines except if Lake Powell is in the Middle Elevation Release Tier or Lower Elevation Balancing Tier, when an adjustment could be made to reduce the annual volume to no less than 6.0 maf. This adjustment would be permissible only if the minimum probable scenario in the 24-Month Study shows Lake Powell dropping below 3,500 feet at any point in the following 12 months. This provides a buffer above the minimum power pool, which is at 3,490 feet. This is not specifically for power generation purposes, but instead to protect critical infrastructure that enables reliable water delivery from Lake Powell through the Grand Canyon and into Lake Mead. The analysis showed that the Proposed Action balances risks between Lake Powell and Lake Mead better than the No Action alternative, as demonstrated in the graph on p. 2 of the Dear Reader Letter to the Revised Draft SEIS. In addition, the ability to reduce Lake Powell releases to 6.0 maf, the Secretary's ongoing reserved authority to take emergency actions, and the SEIS conservation in the Lower Basin states, show that the system is more protected than under the No Action Alternative. The 3.0 maf of additional SEIS conservation reduces the risk of involuntary shortages to water users compared with the No Action Alternative because it provides for additional water to remain in Lake Mead, thereby increasing Lake Mead elevations.
288	14	ALTNO - No Action Alternative	The Lower Basin Plan, the only alternative from which to compare the No Action Alternative in the Revised Draft SEIS, makes no adjustments to the reservoir elevations associated with the operational tiers as define in Table 2-2.32 Only two changes are proposed in Table 2-5 for the Proposed Action including: 1) the addition of language to the Mid-Elevation and Lower Elevation Tiers that "if any minimum probable Lake Powell elevation projection shows Lake Powell <3,500 feet over the next months, reduce releases to a minimum of 6.0 maf to maintain an elevation of 3,500 feet"; and 2) "[t]he Secretary reserves the right to operate Reclamation facilities to protect the Colorado River system if hydrologic conditions require such action." Table 2-5 also states that the Lake Powell operational tiers are "subject to April adjustments or mid-year review modifications," this is the same in the No Action Alternative.	The range of alternatives analyzed in this SEIS is reasonable. Action Alternatives 1 and 2 were considered in the original Draft SEIS but were ultimately dismissed from detailed analysis in the revised Draft SEIS because their performance was similar to or worse than the Lower Division proposal (now the Proposed Action) as explained in the Dear Reader Letter to the Revised Draft SEIS and Section 2.8. Reclamation analyzed the Lower Division Proposal (now the Proposed Action) at the request of the Seven Basin States. The current range of alternatives thus meets the purpose and need to address low reservoir conditions across the Basin in the short term and, perhaps more importantly, provides the space “so that all parties can focus their resources on the development of the post-2026 guidelines” as described by the Seven Basin States. In addition, the ability to reduce Lake Powell releases to 6.0 maf, the Secretary's ongoing reserved authority to take emergency actions, and the SEIS conservation in the Lower Basin states, show that the system is more protected than under the No Action Alternative.

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288	24	ALTNO - No Action Alternative	while the results of the modeling are less extreme than they were in the April Draft SEIS, there are real risks still present for the Colorado River and its resources. Traces from the most recent modeling, with June 2023 hydrology, still show traces reaching minimum power pool at Lake Powell from early 2025 through 2026. If those traces were to come to fruition there would be significant impacts on the environmental, cultural, and recreational resources in Grand and Marble Canyons. The fact that Reclamation prematurely and without a reasonable explanation eliminated Alternatives A and B leaves the entire effects analysis solely based on how the proposed action performs next to doing nothing. This leads to a much less informative and effective analysis from which to make critical decisions for the basin. hydrologic inputs make a significant difference in the outcome of the analysis. See the Dear Reader Letter in the Revised Draft SEIS. For example, Reclamation reassessed the hydrology between the April Draft SEIS and the October Revised Draft SEIS for the No Action Alternative and concluded that the updated hydrology modeling shows that even no action presents much lower risk of reaching critical elevations at Lake Powell and Lake Mead through 2026 than prior hydrology modeling from September 2022. While the No Action Alternative is often not a reasonable mechanism to achieve the purpose and need of a federal action, the change in hydrology, short timeframe, and corresponding change in risk may make the No Action Alternative viable here.	The range of alternatives analyzed in this SEIS is reasonable. Action Alternatives 1 and 2 were considered in the original Draft SEIS but were ultimately dismissed from detailed analysis in the revised Draft SEIS because their performance was similar to or worse than the Lower Division proposal (now the Proposed Action) as explained in the Dear Reader Letter to the Revised Draft SEIS and Section 2.8. Reclamation remodeled Action Alternatives 1 and 2 based on the June 2023 hydrology during preparation of the Revised DSEIS and the analysis showed that the Proposed Action balances risks between Lake Powell and Lake Mead better than the operational tiers considered in Action Alternatives 1 and 2, as demonstrated in the graph on p. 2 of the letter. Action Alternatives 1 and 2 were therefore moved to the alternatives considered but eliminated from detailed analysis section. The current range of alternatives meets the purpose and need to address low reservoir conditions across the Basin in the short term and, perhaps more importantly, provides the space "so that all parties can focus their resources on the development of the post-2026 guidelines" as described by the Seven Basin States.
556	1	ALTNO - No Action Alternative	No Action Alternative: Southern Ute does not support selection of the No Action Alternative set forth in the Revised DSEIS. Although in the winter of 2022-23 snowfall in the Upper Basin exceeded recent trends, one year of improved hydrology does not change the fact that the Colorado River Basin is experiencing an ongoing drought. In the past few years, we have seen elevations in Lake Powell and Lake Mead decline to historically low levels. The current operating guidelines are not protecting critical elevations at either reservoir. The Tribe does not support the continuation of the current operating guidelines with Reclamation taking no additional action to deal with the ongoing drought conditions and climate change, Going forward, we must ensure there is a plan in place to address the likelihood of the continuation of declining elevations and system shortages.	Thank you for your comment.
127	1	ALTNODET - Alternatives Not Analyzed In Detail	SEIS option 3 is best, if not cloud seeding the 15-Mile Reach at the beginning of the Colorado River. The Inflation Reduction Act allocated $4.6 billion to drought relief aka permanent fallowing farm land used to export hay for cows and horses.	Thank you for your comment.
288	3	ALTNODET - Alternatives Not Analyzed In Detail	Reclamation should either fully analyze Alternatives 1 and 2 in the Revised Draft SEIS including the full range of its environmental consequences or, at a minimum, Reclamation should take the feedback received and develop an additional alternative that fully analyzes a range of futures that can either justify moving forward with the proposed action or perhaps show that a new alternative may have broader appeal and more benefit up to and post-2026.	The range of alternatives analyzed in this SEIS is reasonable. Action Alternatives 1 and 2 were considered in the original Draft SEIS but were ultimately dismissed from detailed analysis in the revised Draft SEIS because their performance was similar to or worse than the Lower Division proposal (now the Proposed Action) as explained in the Dear Reader Letter to the Revised Draft SEIS and Section 2.8. Reclamation analyzed the Lower Division Proposal (now the Proposed Action) at the request of the Seven Basin States. The current range of alternatives thus meets the purpose and need to address low reservoir conditions across the Basin in the short term and, perhaps more importantly, provides the space "so that all parties can focus their resources on the development of the post-2026 guidelines" as described by the Seven Basin States.

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288	10	ALTNODET - Alternatives Not Analyzed In Detail	by excluding Alternatives 1 and 2 from full analysis in the Revised Draft SEIS, deprives itself, the other basin sovereigns, stakeholders, and the public from the ability to assess the risks of reaching critical reservoir elevation or realizing benefits of reservoir stabilization and recovery and the associated effects to the environment	The range of alternatives analyzed in this SEIS is reasonable. Action Alternatives 1 and 2 were considered in the original Draft SEIS but were ultimately dismissed from detailed analysis in the revised Draft SEIS because their performance was similar to or worse than the Lower Division proposal (now the Proposed Action) as explained in the Dear Reader Letter to the Revised Draft SEIS and Section 2.8. Reclamation analyzed the Lower Division Proposal (now the Proposed Action) at the request of the Seven Basin States. The current range of alternatives thus meets the purpose and need to address low reservoir conditions across the Basin in the short term and, perhaps more importantly, provides the space "so that all parties can focus their resources on the development of the post-2026 guidelines" as described by the Seven Basin States.
288	11	ALTNODET - Alternatives Not Analyzed In Detail	Reclamation fails to analyze a reasonable range of alternatives as required by NEPA. Reclamation should have carried through and fully analyzed Alternatives 1 and 2 with the selected alternatives in the Revised Draft SEIS.	The range of alternatives analyzed in this SEIS is reasonable. Action Alternatives 1 and 2 were considered in the original Draft SEIS but were ultimately dismissed from detailed analysis in the revised Draft SEIS because their performance was similar to or worse than the Lower Division proposal (now the Proposed Action) as explained in the Dear Reader Letter to the Revised Draft SEIS and Section 2.8. Reclamation analyzed the Lower Division Proposal (now the Proposed Action) at the request of the Seven Basin States. The current range of alternatives thus meets the purpose and need to address low reservoir conditions across the Basin in the short term and, perhaps more importantly, provides the space "so that all parties can focus their resources on the development of the post-2026 guidelines" as described by the Seven Basin States.
288	15	ALTNODET - Alternatives Not Analyzed In Detail	A much broader range of suggested policy changes are found within the other four alternatives Reclamation failed to carry forward into its analysis in the Revised Draft SEIS. For example, Reclamation proposed several changes in its Alternatives 1 and 2 including: 1) combining the Mid- Elevation and Lower Elevation Tiers into a single new Lower Elevation Release Tier; 2) setting the initial release of the new Lower Elevation Release Tier to 6.0 maf; 3) adjusting releases based on April end-of-water-year elevation projections for Lake Powell; 4) exploring adjustments based the following range of elevations: (= 3,575 feet, release 8.23 maf), (< 3,575 feet and = 3,550 feet, release 7.48 maf), (< 3,550 feet and =3,535 feet, release 7.0 maf),(< 3,525 feet and = 3,500 feet, maintain 6.0 maf release), (< 3,500 feet, reduce releases so gains equal losses, so Lake Powell ends year at 3,500 feet); and 5) adding a protection level of 3,500 feet at Lake Powell. See Table 2-6 in the April Draft SEIS	The range of alternatives analyzed in this SEIS is reasonable. Alternatives that modified operational tiers were considered in the Original Draft SEIS. But alternatives with such modifications were ultimately dismissed from detailed analysis because their performance was similar to or worse than the Lower Division proposal as explained in the Dear Reader Letter to the Revised Draft SEIS and Section 2.8. The analysis showed that the Proposed Action balances risks between Lake Powell and Lake Mead better than the operational tiers considered in Action Alternatives 1 and 2, as demonstrated in the graph on p. 2 of the letter. Action Alternatives 1 and 2 were therefore moved to the alternatives considered but eliminated from detailed analysis section. In addition, the ability to reduce Lake Powell releases to 6.0 maf, the Secretary's ongoing reserved authority to take emergency actions, and the SEIS conservation in the Lower Basin states, do show that the system is more protected than under the No Action Alternative as well as Action Alternatives 1 and 2 from the Original Draft SEIS.
288	16	ALTNODET - Alternatives Not Analyzed In Detail	A few of these changes were carried forward into the Lower Basin Proposal including the protection elevation at 3,500 feet and the 6.0 maf release; however, how the 6 maf release is implemented in the Lower Basin Plan is different than in Alternatives 1/2. In the Lower Basin Plan, the release reduction to 6.0 maf is triggered by Lake Powell being projected to reach the protection level of 3,500 feet. On the other hand, Alternatives 1 and 2 set an initial release of 6.0 maf and adjust releases upward or hold based on April Lake Powell end-of-water-year elevation projections. It is impossible to weigh the benefits or risks of the nuance in this policy because the policies related to operation in Alternatives 1 and 2 were not analyzed against those in the Proposed Action, nor were their environmental effects evaluated.	Reclamation remodeled Action Alternatives 1 and 2 based on the June 2023 hydrology during preparation of the Revised DSEIS as discussed in the Dear Reader Letter to the Revised Draft SEIS. The analysis showed that the Proposed Action balances risks between Lake Powell and Lake Mead better than the operational tiers considered in Action Alternatives 1 and 2, as demonstrated in the graph on p. 2 of the letter. Action Alternatives 1 and 2 were therefore moved to the alternatives considered but eliminated from detailed analysis section.

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288	17	ALTNODET - Alternatives Not Analyzed In Detail	Also, as mentioned above, Reclamation modeled a range of suggested policy changes, including those relevant to operational tiers, in Appendix B in April Draft SEIS based on September 2022 hydrology. The 6-States Plan, California Plan, the Utton Center Plan included suggested operational policy changes including: 1) reducing releases from Glen Canyon Dam to protect elevation 3,500 feet (6- State Plan and California Plan) or 3,515 feet (Utton Center Plan); 2) changing set release at elevation 3,575 feet to 7.48 maf (6-States Plan) or to range from 7 maf to 8.23 maf (California Plan); 3) below 3,575 feet balancing release while protecting elevation 3,515 feet in Lake Powell and 975 feet in Lake Mead (Utton Center Plan), 4) removing operational neutrality (e.g. using actual elevations to determine tiers) (California Plan); among other proposals.36 Reclamation did not conduct a similar modeling analysis in the Revised Draft SEIS for these alternatives under the June 2023 hydrology. This omission renders Reclamation's analysis incomplete and ineffective to evaluate a reasonable range of alternatives to inform its policy decision. As a result, the failure of Reclamation to include a reasonable range of alternatives in the Revised Draft SEIS continues to plague its analysis. A reasonable range of alternatives is key for the basin sovereigns, stakeholders, and the public to engage meaningfully in the discussion around choosing a path forward. This is even true when the action is in the short-term. Reclamation needs to remedy this oversight before it finalizes its analysis and decides how and with which alternative to proceed.	Reclamation modeled these proposals in Appendix B of the Original Draft SEIS. These were not moved forward as alternatives for full consideration. Reclamation remodeled Action Alternatives 1 and 2 based on the June 2023 hydrology during preparation of the Revised DSEIS as discussed in the Dear Reader Letter to the Revised Draft SEIS, which resulted in the current range of alternatives.
288	19	ALTNODET - Alternatives Not Analyzed In Detail	Reclamation failed to justify a valid reason for not carrying forward at least four of the "considered by eliminated" alternatives - Reclamation failed to include the 6-States Plan and California Plan as alternatives to the proposed action in both the April and October Draft SEIS - Reclamation failed to justify its decision to eliminate the 6-State Plan. On January 31, 2023, the 6-basin states (Arizona, Colorado, Nevada, New Mexico, Utah, and Wyoming) submitted an alternative to Reclamation "that apportions among all contractors reductions to account for water evaporation, seepage, and system losses."41 Reclamation also received scoping comments that were in favor of such an alternative, including from the Trust.42 Reclamation refused to carry it forward in both the April Draft SEIS and the Revised Draft SEIS based on the reasoning that "the Proposed Action contemplates conservation amounts similar to those that would be assessed based on evaporation, seepage, and system loss calculations in the proposals received." 43 In fact, the amount of water conservation proposed by the 6-States Plan significantly outpaces the conservation proposed in the proposed action. More specifically, the 6-State Plan proposed shortage amounts that exceed those in the Lower Basin Plan by more than 800,000 acre-feet (at higher elevations, Tier 0 < 1090 feet) and by 1.5 maf (at lower elevations, Tier 3b < 1020). Reclamation may have had more solid ground to stand on when it made that statement in the April Draft SEIS because that analysis also included Alternatives 1 and 2, which have significantly more water conservation than the proposed action. The fact is the Lower Basin Plan and the No Action Alternative do not contemplate nor analyze fully similar conservation amounts in this Revised Draft SEIS. Thus, Reclamation cannot justify eliminating this alternative from consideration in the Revised Draft SEIS unless it were to consider another alternative that assessed similar demand reductions and policy amounts like Reclamation's Alternatives 1 and 2.	As commenter states, 6-state plan is similar to Action Alts 1 and 2, which were outperformed by the Proposed Action. The rationale for dismissal is the same.

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288	20	ALTNODET - Alternatives Not Analyzed In Detail	b. Reclamation failed to justify its decision to eliminate the California Plan. On January 31, 2023, California proposed an alternative to be analyzed in the April Draft SEIS. This alternative was not even mentioned as "considered but eliminated from detailed analysis" in either Section 2.9 of the April Draft SEIS or Section 2.8 in the Revised Draft SEIS.44 The California Plan, however, was incorporated into Appendix B of the April Draft SEIS and it was run through Reclamation's model based on the September 2022 hydrology.45 The proposal offered revisions to the 2007 Interim Guidelines related to upper basin demand management, Glen Canyon Dam operations, and lower basin demand reductions. The shortages proposed are clearly more substantial than those incorporated into the Lower Basin Plan/Proposed Action. Reclamation failed to provide its reasoning for why this plan was not even included in the considered but eliminated category or why it ultimately was not analyzed or carried forward into the Revised Draft SEIS. We believe this alternative contains policy revisions that Reclamation could and should have considered and analyzed in the Revised Draft SEIS.	As stated in Section 2.1, Reclamation carefully reviewed the proposal from California, along with others received. Several of these proposals were analyzed in the original Draft SEIS in Appendix B in terms of their hydrologic performance over the remainder of the interim period. These proposals were similar to the actions considered in Action Alternatives 1 and 2 in the original Draft SEIS and are similarly affected by the improved June 2023 hydrology. Reclamation is not remodeling these proposals or comparing them against the Proposed Action for the same reasons that Action Alternatives 1 and 2 have been eliminated (see the Dear Reader Letter to the Revised Draft SEIS and Section 2.8.10).
288	21	ALTNODET - Alternatives Not Analyzed In Detail	Reclamation's analysis in Appendix B does not support its analysis to eliminate Alternatives 1 and 2 because of their impact on reservoir elevations at Lake Mead. The sovereigns, stakeholders, and the public are relying on Reclamation's expertise and careful analyses to guide important decisions in the basin. Reclamation's less than consistent and thorough analysis to evaluate Alternatives 1 and 2 against the No Action and Proposed Action gives us pause about the veracity of the remainder of the analysis. Reclamation must either revisit its hydrologic analysis in Appendix B to further evaluate Alternatives 1 and 2 or simply determine that these alternatives belong in the Draft SEIS and should fully analyze and include in the FEIS due to the benefits they provide to meeting the purpose and need of the proposed action. Let's not forget that these alternatives were fully analyzed, albeit under different hydrology, in the April Draft SEIS.	It is Reclamation's view that the Proposed Action, as demonstrated in the Dear Reader Letter to the Revised Draft SEIS (p.2), balances risks between Lake Powell and Lake Mead better than the operational tiers considered in Action Alternatives 1 and 2 through 2026. The hydrologic modeling examines scenarios based on flows in the Basin over the past 30 years, which includes the driest 23-year period on record. To examine even worse drought conditions, the hydrologic modeling examines Basin flow scenarios with 90 percent and 80 percent of the flows seen over the past 30 years (up to a 20 percent reduction in flows compared with the last 30 years).
288	22	ALTNODET - Alternatives Not Analyzed In Detail	Reclamation fails to take a hard look at the direct, indirect, and cumulative effects of the proposed revisions to the 2007 Interim Guidelines - Reclamation fails to take a hard look at the direct and indirect environmental consequences of the no action and proposed actions because it does not analyze and compare a full range of alternatives that allow a meaningful comparison of the environmental effects.	The range of alternatives analyzed in this SEIS is reasonable. Action Alternatives 1 and 2 were considered in the original Draft SEIS but were ultimately dismissed from detailed analysis in the revised Draft SEIS because their performance was similar to or worse than the Lower Division proposal (now the Proposed Action) as explained in the Dear Reader Letter to the Revised Draft SEIS and Section 2.8. Reclamation analyzed the Lower Division Proposal (now the Proposed Action) at the request of the Seven Basin States, and that analysis shows that the Proposed Action balances the risk between Lake Mead and Lake Powell better than the alternatives considered in the Original Draft SEIS. The current range of alternatives thus meets the purpose and need to address low reservoir conditions across the Basin in the short term and, perhaps more importantly, provides the space “so that all parties can focus their resources on the development of the post-2026 guidelines” as described by the Seven Basin States.

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288	23	ALTNODET - Alternatives Not Analyzed In Detail	Reclamation's failure to analyze an adequate range of alternatives cripples any meaningful comparison of the environmental effects of the proposed action. As an initial matter, Reclamation hinders its own environmental effects analysis by failing to analyze a reasonable range of alternatives to the proposed action. Reclamation uses hydrologic modeling to assess the effects of the alternatives' in this case only the no action and proposed action alternatives. Thus, the hydrologic modeling only works to compare alternatives that are analyzed using the same parameters. In this case, Reclamation only provided a detailed and complete analysis of the no action and proposed action under June 2023 hydrology. While Reclamation indicated that it conducted an analysis of its Alternatives 1 and 2 from the April Draft SEIS in its Dear Reader Letter and Appendix B, it does not utilize these data in its effects analysis because it "considered but eliminated" these alternatives before releasing its October Revised SEIS for public comment. Therefore, Reclamation's effects analysis is extremely limited to the difference between doing nothing in the basin to address "historic drought, historically low reservoir elevations, and low-runoff conditions in the Basin" and taking steps proposed in the proposed action.66	The range of alternatives analyzed in this SEIS is reasonable. Action Alternatives 1 and 2 were considered in the original Draft SEIS but were ultimately dismissed from detailed analysis in the revised Draft SEIS because their performance was similar to or worse than the Lower Division proposal (now the Proposed Action) as explained in the Dear Reader Letter to the Revised Draft SEIS and Section 2.8. Reclamation remodeled Action Alternatives 1 and 2 based on the June 2023 hydrology during preparation of the Revised DSEIS as discussed in the letter. The analysis showed that the Proposed Action balances risks between Lake Powell and Lake Mead better than the operational tiers considered in Action Alternatives 1 and 2, as demonstrated in the graph on p. 2. Action Alternatives 1 and 2 were therefore moved to the alternatives considered but eliminated from detailed analysis section. The current range of alternatives meets the purpose and need to address low reservoir conditions across the Basin in the short term and, perhaps more importantly, provides the space “so that all parties can focus their resources on the development of the post-2026 guidelines” as described by the Seven Basin States.
288	29	ALTNODET - Alternatives Not Analyzed In Detail	Reclamation should be analyzing at least one additional alternative to the selected alternatives that conserves even more water in Lake Powell both as a meaningful comparison for the selected alternatives and to understand the impact such elevations could have on this and other critical resource issues downstream of Glen Canyon Dam.	The range of alternatives analyzed in this SEIS is reasonable and meets the purpose and need to address low reservoir conditions across the Basin in the short term and, perhaps more importantly, provides the space “so that all parties can focus their resources on the development of the post-2026 guidelines” as described by the Seven Basin States.
288	30	ALTNODET - Alternatives Not Analyzed In Detail	Alternatives 1 and 2 provide greater protection of reservoir elevations at Lake Powell than the selected alternatives. A comparison of these resources in Chapter 3 of the Revised Draft SEIS did not occur as related to Alternatives 1 and 2 because they were not carried forward. The risk of increased water temperatures due to low reservoir elevations is important given that smallmouth bass are already reproducing in Marble Canyon and possibly Grand Canyon below the dam. Warmer temperatures facilitate this reproduction and could lead to establishment of the species below the dam. This is an incredible threat to the threatened humpback chub, which has its most robust and last stronghold population in the Colorado River Basin. An estimated 92% of all humpback chub live in the Colorado River in Grand Canyon.84 While Reclamation is working to address this threat in the context of the LTEMP SEIS, its choices around alternatives for this SEIS are critical to how much mitigation will have to be done on the part of Reclamation and the Park Service to modify reservoir operations (specifically where water is released from) in the LTEMP SEIS.	Action Alternatives 1 and 2 were considered in the original Draft SEIS but were ultimately dismissed from detailed analysis in the revised Draft SEIS because their performance was similar to or worse than the Lower Division proposal (now the Proposed Action) as explained in the Dear Reader Letter to the Revised Draft SEIS and Section 2.8. Reclamation remodeled Action Alternatives 1 and 2 based on the June 2023 hydrology during preparation of the Revised DSEIS as discussed in the letter. The analysis showed that the Proposed Action balances risks between Lake Powell and Lake Mead better than the operational tiers considered in Action Alternatives 1 and 2, as demonstrated in the graph on p. 2 letter. Action Alternatives 1 and 2 were therefore moved to the alternatives considered but eliminated from detailed analysis section. Sections 3.8 and 3.13 discuss water temperature and smallmouth bass. This issue is addressed further in the LTEMP SEIS. We encourage comment in the EIS process associated with LTEMP, which will address, among other things, cumulative effects of this SEIS on the LTEMP SEIS.

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288	35	ALTNODET - Alternatives Not Analyzed In Detail	Reclamation has authority under both the Grand Canyon Protection Act and the Endangered Species Act to consider and ensure that the environmental and cultural resources as well as endangered and threatened species are protected and any harm is mitigated. As demonstrated throughout these comments, the selected alternatives do not ensure that Lake Powell does not reach critical elevations and traces show the reservoirs could hover around 3,500 for most of 2025 and 2026. To understand other possible paths forward and to compare a more protective path with the alternatives analyzed, Reclamation needs to either carry forward Alternative 1 and 2 or develop a combination alternative that contemplates additional demand reductions, reservoir operations and other policies that meets the mandates of the Law of the River, but also the GCPA, ESA, and other environmental laws.	The range of alternatives analyzed in this SEIS is reasonable. Action Alternatives 1 and 2 were considered in the original Draft SEIS but were ultimately dismissed from detailed analysis in the revised Draft SEIS because their performance was similar to or worse than the Lower Division proposal (now the Proposed Action) as explained in the Dear Reader Letter to the Revised Draft SEIS and Section 2.8. Reclamation analyzed the Lower Division Proposal (now the Proposed Action) at the request of the Seven Basin States, and that analysis shows that the Proposed Action balances the risk between Lake Mead and Lake Powell better than the alternatives considered in the Original Draft SEIS. The current range of alternatives thus meets the purpose and need to address low reservoir conditions across the Basin in the short term and, perhaps more importantly, provides the space "so that all parties can focus their resources on the development of the post-2026 guidelines" as described by the Seven Basin States. In addition, the ability to reduce Lake Powell releases to 6.0 maf, the Secretary's ongoing reserved authority to take emergency actions, and the SEIS conservation in the Lower Basin states, show that the system is more protected than under the No Action Alternative. Both alternatives are consistent with the GCPA. This SEIS concerns annual releases through the Grand Canyon, but the implications for more particular subannual releases are described in Section 2.7.2.
288	38	ALTNODET - Alternatives Not Analyzed In Detail	While we generally support revisions to the 2007 interim guidelines we believe Reclamation needs to consider 1) updating the purpose and need statement, 2) ensuring analysis of the full range of reasonable alternatives by either fully analyzing Alternatives 1 and 2 in the Revised Draft SEIS or developing at least one additional alternative that provides benefit to reservoir elevations up to and post-2026 while protecting environmental and cultural resources of the Grand Canyon, and 3) running other considered but eliminated alternatives (e.g. 6-States Plan, California Plan, etc.) through the updated June 2023 hydrology for useful comparison.	The purpose and need is sufficient to meet the low-runoff conditions in the basin until the Post-2026 process is complete. The range of alternatives analyzed in this SEIS is reasonable. Action Alternatives 1 and 2 were considered in the original Draft SEIS but were ultimately dismissed from detailed analysis in the revised Draft SEIS because their performance was similar to or worse than the Lower Division proposal (now the Proposed Action) as explained in the Dear Reader Letter and Section 2.8. As explained in the Dear Reader Letter to the revised Draft SEIS, Reclamation analyzed the Lower Division Proposal (now the Proposed Action) at the request of the Seven Basin States, and that analysis shows that the Proposed Action balances the risk between Lake Mead and Lake Powell better than the alternatives considered in the Original Draft SEIS. The current range of alternatives thus meets the purpose and need to address low reservoir conditions across the Basin in the short term and, perhaps more importantly, provides the space "so that all parties can focus their resources on the development of the post-2026 guidelines" as described by the Seven Basin States. Reclamation remodeled Action Alternatives 1 and 2 based on the June 2023 hydrology during preparation of the Revised DSEIS as discussed in the Dear Reader Letter to the Revised Draft SEIS. The analysis showed that the Proposed Action balances risks between Lake Powell and Lake Mead better than the operational tiers considered in Action Alternatives 1 and 2, as demonstrated in the graph on p. 2 of the letter. Reclamation modeled other submitted proposals in Appendix B of the Original Draft SEIS. These proposals were similar to the actions considered in Action Alternatives 1 and 2 in the original Draft SEIS and are similarly affected by the improved June 2023 hydrology. Reclamation is not remodeling these proposals or comparing them against the Proposed Action for the same reasons that Action Alternatives 1 and 2 have been eliminated (see the Dear Reader Letter and Section 2.8.10).

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292	1	ALTNODET - Alternatives Not Analyzed In Detail	We appreciate that Alternatives 1 and 2, which were included in the original draft SEIS in April 2023, have been "addressed as alternatives considered but eliminated from detailed analysis." However, in Section 2.4, the Revised Draft SEIS indicates that "The Department may select different parts of any of the alternatives to best meet the Purpose and Need." Selection of elements of Alternatives I and 2 could significantly disrupt not only the near-term operations, but the process for development of Post-2026 Operational Guidelines. The analysis of the alternatives is insufficient to include any elements of Alternative 1 and 2 in the final SEIS. As acknowledged in the Revised Draft SEIS, both the Proposed Alternative and the No Action Alternative satisfy the Purpose and Need. The final SEIS should clarify that elements of Alternatives 1 and 2 will not be included in the preferred alternative.	The language stating the Department may select different parts of any of the alternatives has been removed.
295	2	ALTNODET - Alternatives Not Analyzed In Detail	Also, it is important to note NRDC strongly supports alternative analyses covering the original 2-4M AFY range that USBR was recommending prior to the 22-23 precipitation year. The draft SEIS demonstrates that the USBR has chosen to defer major Colorado River operations decisions until the Post-2026 period - a major lost opportunity to provide additional Lake Mead storage volumes and insurance for the 30 million plus people reliant lower Colorado flows during this interim period.	Action Alternatives 1 and 2 were considered in the original Draft SEIS but were ultimately dismissed from detailed analysis in the revised Draft SEIS because their performance was similar to or worse than the Lower Division proposal (now the Proposed Action) as explained in the Dear Reader Letter to the Revised Draft SEIS and Section 2.8. As explained in the Dear Reader Letter to the revised Draft SEIS, Reclamation analyzed the Lower Division Proposal (now the Proposed Action) at the request of the Seven Basin States, and that analysis shows that the Proposed Action balances the risk between Lake Mead and Lake Powell better than the alternatives considered in the Original Draft SEIS. The current range of alternatives thus meets the purpose and need to address low reservoir conditions across the Basin in the short term and, perhaps more importantly, provides the space “so that all parties can focus their resources on the development of the post-2026 guidelines” as described by the Seven Basin States.
295	5	ALTNODET - Alternatives Not Analyzed In Detail	Add the two 2m AFY scenarios back into the SEIS and seriously consider them for near-term actions	Action Alternatives 1 and 2 were considered in the original Draft SEIS but were ultimately dismissed from detailed analysis in the revised Draft SEIS because their performance was similar to or worse than the Lower Division proposal (now the Proposed Action) as explained in the Dear Reader Letter to the Revised Draft SEIS and Section 2.8. Reclamation analyzed the Lower Division Proposal (now the Proposed Action) at the request of the Seven Basin States, and that analysis shows that the Proposed Action balances the risk between Lake Mead and Lake Powell better than the alternatives considered in the Original Draft SEIS. The current range of alternatives thus meets the purpose and need to address low reservoir conditions across the Basin in the short term and, perhaps more importantly, provides the space “so that all parties can focus their resources on the development of the post-2026 guidelines” as described by the Seven Basin States.
295	6	ALTNODET - Alternatives Not Analyzed In Detail	The Bureau should identify and enforce best practices for the avoidance of waste by all Lower Colorado contractors. As part of this process, Reclamation should articulate the criteria or standards that will guide its determinations of beneficial use of water, in a form that lends itself to objective application, monitoring, and compliance assurance to eliminate wasteful use. Such savings should be part of the baseline of each action alternative described in the SEIS.	Any evaluation of provisions related to Part 417 beneficial use is an independent process to ongoing NEPA activities in the lower Colorado River basin.

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296	1	ALTNODET - Alternatives Not Analyzed In Detail	we are still concerned that Reclamation has not acknowledged that Alternative 2 is unreasonable under NEPA as it is in violation of the 2006 consolidated decree in Arizona v California("Decree"). As Reclamation is aware, the United States Supreme Court enjoined Reclamation from operating works on the lower Colorado River except as specified in Article II of the Decree. And Article II of the Decree specifies that CRIT, as a holder of Present Perfected Rights, will be among the last users on the entire system to take a shortage. Simply put, Alternative 2, or any other alternative that seeks to unilaterally reduce deliveries to CRIT in violation of the Decree, is neither reasonable nor legally feasible. Yet the Revised DSEIS does not acknowledge this simple fact of law. Instead, Reclamation states that Alternative 2 will "not provide additional risk reduction" when compared with the proposed action and therefore warrants no further consideration. Revised DESIS 2-18. Our concern over the failure of Reclamation to address this point in clear and unambiguous terms is heightened by language on page 1-1 of the Revised DSEIS, which states: Reclamation operates Hoover Dam and other major facilities in the Lower Basin pursuant to the Boulder Canyon Project Act (BCPA) and other related federal statutes. This statement is only partially correct, as it fails to acknowledge the Decree as a foundational document in Reclamation's operations on the Colorado River. Reclamation should clarify for this and all future actions on the Colorado River that it does not have the legal authority to take actions such as those embodied in Alternative 2 because doing so would be in violation of the clear injunctive language of the Supreme Court in the Decree. It would also be in violation of the requirements of the National Environmental Policy Act regarding the reasonableness of alternatives. Until Reclamation directly, clearly, and publicly acknowledges this fact of law, there will likely be continued confusion and unfounded expectations regarding the range of lawful potential alternatives available to Reclamation. We therefore specifically request that you make this point clear in the final document.	Action Alternative 2 has been moved into the Alternatives Considered but Eliminated section of the SEIS (see Section 2.8).

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297	7	ALTNODET - Alternatives Not Analyzed In Detail	The need to study full bypass of Glen Canyon Dam and model operations with low and no reservoir scenarios at Lake Powell As demonstrated by the charts above and acknowledging Reclamations' own 5-year projections21, there is a significant enough likelihood of Powell dropping below power pool and near deadpool that Reclamation should have every operational tool available to manage the system in low system hydrologic scenarios. Currently those tools are unavailable, because of infrastructure limitations at Glen Canyon Dam, and the lack of predictive modeling utilizing alternative scenarios where Lake Powell is hydrologically drawn down to low levels or run-of-river level. The recent strategy from Reclamation23 is centered around propping up Lake Powell enough to meet legal requirements through increased releases from upstream reservoirs, and reduction of releases downstream. These efforts will only work in the short-term and don't address the important structural problem of Glen Canyon Dam's inability to meet legal delivery requirements downstream. In an announcement on August 16th, 2022 22, Reclamation outlined a number of actions it would take to address falling levels at Lake Powell. One of these actions states Reclamation will, "Take administrative actions needed to authorize a reduction of Glen Canyon Dam releases below 7 million acre-feet per year, if needed, to protect critical infrastructure at Glen Canyon Dam." This action highlights one of the structural limitations at Glen Canyon Dam, specifically its ability to operate and move water downstream to the Lower Basin States and Mexico solely through use of the river outlet works for months or years at a time. Tanya Trujillo, former Assistant Secretary for Water and Science, in an announcement stated, "Glen Canyon Dam was not envisioned to operate solely through the outlet works for an extended period of time and operating at this low lake level increases risks to water delivery and potential adverse impacts to downstream resources and infrastructure." It's unclear that the physical structure of the river outlet works are capable of safely operating at full capacity for long periods of time. The recent strategy from Reclamation23 is centered around propping up Lake Powell enough to meet legal requirements through increased releases from upstream reservoirs, and reduction of releases downstream. These efforts will only work in the short-term and don't address the important structural problem of Glen Canyon Dam's inability to meet legal delivery requirements downstream.	This SEIS addresses actions in the remainder of the interim period, through 2026. Longer-term planning is being addressed through the Post-2026 process. In the Proposed Action for this SEIS, the ability to reduce Lake Powell releases to 6.0 maf, the Secretary's ongoing reserved authority to take emergency actions, and the SEIS conservation in the Lower Basin states, do show that the system is more protected than under the No Action Alternative through the interim period.
297	12	ALTNODET - Alternatives Not Analyzed In Detail	In February of 2023, Reclamation hosted a webinar describing possible alternatives to re-engineer Glen Canyon Dam so that it may provide limited hydropower generation and continue delivering water at lower levels25. The effort by Reclamation to have a discussion demonstrates there is an urgent need to begin the process of modifying Glen Canyon Dam. [...] Reclamation's ongoing efforts to study the structural modification of Glen Canyon Dam must be incorporated into any near or long term planning on Colorado River operations.	Thank you for your comment. Reclamation is exploring options to address these issues. However, the suggested action is outside the scope of this SEIS.

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297	42	ALTNODET - Alternatives Not Analyzed In Detail	Many leading scientists and policy experts along the Colorado River have advocated for a management approach where Lake Powell and Mead are viewed as one unit of water storage, rather than two separate storage facilities64. Some experts have even made the point that since Upper Basin users don't actually pull water from the reservoir, it is effectively a Lower Basin reservoir. Given the reality that Lake Powell narrowly avoided dipping below minimum power pool last year, and Reclamation is currently assessing re-engineering the dam to operate below deadpool, and a tremendous amount of emerged resources exist in Glen Canyon below its full pool elevation, the DSEIS should have modeled alternatives where Lake Powell is operated at low or even run-of-river levels. These alternatives should include reservoir consolidation, and prioritization of Lake Mead as the Colorado River's primary storage facility. The scenarios modeled should include a rule that utilizes Lake Powell as a backup facility, not to be filled past 3,550 except for emergency situations.	As stated in Section 2.8.3, using Lake Powell as a backup for seasonal and flood control purposes to meet the goals of reducing evaporation and seepage and increasing flexibility for implementing Grand Canyon restoration strategies. This alternative would not meet the federal action's purpose (which focuses on the critically low elevations impacting operations of both Glen Canyon and Hoover Dams during the interim period [prior to January 1, 2027]), and need (which is based on the potential that continued low-runoff conditions in the Basin could lead Lake Powell and Lake Mead to decline to critically low elevations, which would impact operations through the remainder of the interim period).
301	2	ALTNODET - Alternatives Not Analyzed In Detail	Alternatives 1 and 2. Alternatives 1 and 2 were considered but eliminated from a detailed analysis in the SEIS, but section 2.4 states that "different parts of any of the alternatives" may be selected to meet the purpose and need. Since there was not a detailed analysis of the eliminated alternatives, there is inadequate information to incorporate parts from Alternative 1 and 2 into the preferred alternative of the final SEIS.	The language stating the Department may select different parts of any of the alternatives has been removed.
306	4	ALTNODET - Alternatives Not Analyzed In Detail	P. 2-16: The ecological alternative "...was not carried forward for detailed analysis because it does not meet the federal action's purpose, need, or objectives. This is because it does not focus on the critically low elevations impacting operations of both Glen Canyon and Hoover Dams during the interim period (prior to January 1, 2027). Apart from concepts of beneficial-use determinations, Reclamation has limited authorities to mandate water conservation measures in the Lower Basin for ecosystem-based purposes." Again, this is part of Reclamation's obligation, and the language of rejection here could more strongly reflect that obligation.	Reclamation incorporated ecological considerations into all the alternatives, which is evident in how the Proposed Action would minimize ecological impacts as compared to the no action alterative. While perhaps desirable, given the flow conditions the basin is experiencing, prioritizing ecological needs above all others would not meet the purpose and need.

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308	8	ALTNODET - Alternatives Not Analyzed In Detail	The Revised Draft SEIS no longer even includes this analysis nor compares the six Basin States' proposal against the Proposed Action; rather, it dismisses the six Basin States' proposal as similar to the inferior Action Alternatives 1 and 2. Revised Draft SEIS, Section 2. 1. This analysis fails to address that the six Basin States' proposed approach would treat individual users within Arizona and California differently should Lake Mead' s elevation drop below 1, 145 feet, in accordance with their distance from Lake Mead-- a very different than the approach taken in each of the Proposed Action and the previously-analyzed alternatives. The six Basin States' approach would allow evaporation to be accounted for in use totals, whereas the Proposed Action and the No Action Alternative do not account for evaporation in use totals. Tying shortage conditions to the actual evaporation and seepage losses of the River before the point of diversion is a more equitable and sustainable solution over simply allocating shortages either by priority or proportionally per state.	The range of alternatives analyzed in this SEIS is reasonable. Action Alternatives 1 and 2 were considered in the original Draft SEIS but were ultimately dismissed from detailed analysis in the revised Draft SEIS because their performance was similar to or worse than the Lower Division proposal (now the Proposed Action) as explained in the Dear Reader Letter to the Revised Draft SEIS and Section 2.8. Reclamation analyzed the Lower Division Proposal (now the Proposed Action) at the request of the Seven Basin States, and that analysis shows that the Proposed Action balances the risk between Lake Mead and Lake Powell better than the alternatives considered in the Original Draft SEIS. The current range of alternatives thus meets the purpose and need to address low reservoir conditions across the Basin in the short term and, perhaps more importantly, provides the space "so that all parties can focus their resources on the development of the post-2026 guidelines" as described by the Seven Basin States. Reclamation modeled the 6-state proposal along with others received in Appendix B of the Original Draft SEIS. These proposals were similar to the actions considered in Action Alternatives 1 and 2 in the original Draft SEIS and are similarly affected by the improved June 2023 hydrology. Reclamation is not remodeling these proposals or comparing them against the Proposed Action for the same reasons that Action Alternatives 1 and 2 have been eliminated (see the Dear Reader Letter and Section 2.8.10).
310	18	ALTNODET - Alternatives Not Analyzed In Detail	In considering only the Proposed Action and a No Action Alternative, the RDSEIS fails to analyze a reasonable range of other Alternatives. By its own admission, the Bureau recognizes that the Proposed Action and the No Action Alternatives are not the only possible scenarios. The main goal of the Proposed Action seems to be to keep reservoir levels high enough so that Lake Powell, and perhaps to a lesser extent, Lake Mead, can continue to produce hydroelectricity. While this will attempt to ensure that the reservoirs stay at a level above dead pool, it nonetheless causes environmental, socioeconomic, and environmental justice effects that are significant and unmitigated. The Bureau must analyze a resource protection alternative that acknowledges its obligations under the Grand Canyon Protection Act, Executive Order 12114, and the Endangered Species Act, as well as other laws and Native American rights.	As described in the Dear Reader Letter to the Revised Draft SEIS, this is a reasonable range of alternatives that meet the purpose of and need for the SEIS covering this short-term planning period through the end of 2026. Comments received during scoping suggested that Reclamation design an alternative that maintains Colorado River flows and supports ecosystem needs; however, the Proposed Action meets all obligations under the Grand Canyon Protection Act, Executive Order 12114 (through incorporating Minute 323), and the Endangered Species Act. The Grand Canyon Protection Act applies more to the timing of sub-annual flows, while this SEIS considers changes to annual flows. The BA currently prepared for this SEIS analyzes reduced deliveries up to 2.5 maf annually in total. This SEIS analysis extends down to the Southerly International Boundary with Mexico.

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319	2	ALTNODET - Alternatives Not Analyzed In Detail	As to the remaining substance of the revised draft SEIS, we note that the caliber of the environmental analysis is improved from that of the original draft SEIS, a representative sample of whose shortcomings we noted in our letter to you of June 9, 2023. That is a good development. We are also pleased to see that Reclamation has abandoned in the revised draft SEIS further consideration of what had been denominated as alternative two in the original draft SEIS. We are disappointed, however, that Reclamation has purported to do so only because both the proposed action and the no-action alternative now outperform that alternative. While we are glad this is true, it nonetheless continues to ignore the fact that Reclamation lacks the legal authority to impose out-of-priority cuts - such as those contemplated in former alternative two - on our Tribe or the other tribes whose water rights were decreed in Arizona v. California. We addressed this issue in detail in our letter to you of June 9, 2023, and reiterate the request we made to you then that you acknowledge the accuracy of our analysis. Certainly nothing in the materials, you subsequently shared with us provides any justification for a contrary conclusion.	Reclamation acknowledged on Page 2-2 of the Draft SEIS dated April 2023 and subsequently withdrawn, that the action alternatives proposed at that time reflected input from multiple parties, but that no submission had garnered complete consensus across the Basin. We appreciate your continued interest in developing viable alternatives for Colorado River operating guidelines.
353	3	ALTNODET - Alternatives Not Analyzed In Detail	5. The new draft justifies acceptance of the LDP over the previous Action Alternatives, stating that it provides for greater risk reduction. On the surface, it is unclear how a reduction of 3.0 MAF (LDP) reduces risk more than a reduction of 6.2 MAF (Action Alternatives). After a review of the assumptions used in modeling and analysis, we understand that the Bureau elected in its model to shift the reductions in the Action Alternatives out a year, beginning in 2025 rather than 2024. This change in the modeling assumptions accounts for the difference in performance. It is therefore misleading to state that the LDP "achieves many of the same objectives as Action Alternatives 1 and 2 ... but with additional risk reduction" (from the Dear Reader preface to the SEIS.) The difference in risk reduction stems solely from changing the modeling assumptions. 6. No mention is made in the SEIS of the unaccounted-for evaporation and transportation losses in the LD system. The reductions in the LDP of 3.0 MAF over 3 years are less than the system losses of 1.5 MAF/year. By accepting the LDP, the Bureau is in effect enabling this issue to remain unaddressed. In summary, we urge the Bureau to revise the conclusions of the draft SEIS; make the Lower Division's Proposal a SEIS Alternative and put forward a Proposed Action with more significant reductions in Lower Division usage that are aligned with the Action Alternatives originally proposed. We strongly suggest a Proposed Action with verifiable, accountable results. If Federal tax dollars are to be used to compensate LD water users for conservation, we believe that compensation should only be paid if (1) the LD brings its total usage in line with the Compact allocated amount of 7.5 MAF annually; and (2) an inter-divisional agreement on the methodology of accounting for evaporation and transit loss is reached and implemented; and (3) any compensation is paid only for conserved consumptive use above and beyond those amounts already planned in the LD's DCP and Operational Plans.	The analysis provided in the SEIS indicates the conservation and adjustments to Glen Canyon releases included in the Proposed Action reduces the risk of reaching critical elevations sufficiently for the duration of this action. Adjustments to operations were modeled according to the possible timeline of implementation.

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365	1	ALTNODET - Alternatives Not Analyzed In Detail	The Association appreciates that Reclamation considered compliance with the Law of the River in the Revised Draft SEIS's discussion of' "Alternatives Considered but Eliminated from Detailed Analysis.' See, e.g. , Sections 2.8.2. 2.8.2, and 2.8.3. Nonetheless, in Section 2.4. Reclamation reserves the right to "select different parts of" any of the alternatives to best meet the purpose and need." The Association notes that former Action Alternative 2 envisioned reductions that did not comport with the priority system and thus ran afoul of the Law of the River, threatening the well- entrenched PPRs belonging to the Association's landowners and others. The Association urges Reclamation to refrain from borrowing from former Action Alternative 2 or any other alternative that would imperil PPRs.	This language has been removed from the SEIS given that there is now only one action alternative.
410	3	ALTNODET - Alternatives Not Analyzed In Detail	Finally, the Revised DSEIS creates new triggers involving Lake Powell and Lake Mead that contemplate significant potential future actions on the part of Reclamation and the Lower Division States to protect critical elevations at these reservoirs, but without specifying what those actions may entail or how they would comport with the present NEPA process. Consistent with indications from Reclamation officials, Reclamation should confirm in its final SEIS that such actions will not involve additional involuntary Colorado River shortages.	The Proposed Action does not contemplate changes to Lake Powell operations except the potential reduction of Lake Powell releases under certain circumstances. For Lake Mead, as described in Section 2.7, operations would not change from the Interim Guidelines except that certain triggers for low elevations would prompt additional operational planning, which would occur with appropriate consultation. Moreover, the risk of additional involuntary shortages is low, and Reclamation would not impose additional involuntary shortages without appropriate coordination and consultation. The analysis in the SEIS does not modify any entitlement or applicable statutory, settlement, or contract terms.
484	13	ALTNODET - Alternatives Not Analyzed In Detail	The UCRC believes that the alternatives analysis would have been more complete had Alternatives 1 and 2 been retained in this Revised Draft SEIS. However, more critical is the need for Reclamation to craft a mechanism by which the reductions in the Final SEIS will be mandatory and enforceable and Lake Powell levels will be adequately protected.	Analysis of the Proposed Action was supported by the seven Basin States, and the analysis showed that the Proposed Action balances risks between Lake Powell and Lake Mead better than the operational tiers considered in Action Alternatives 1 and 2, as demonstrated in the graph on p. 2 of the Dear Reader Letter to the Revised Draft SEIS. Action Alternatives 1 and 2 were therefore moved to the alternatives considered but eliminated from detailed analysis section. Reclamation is confident that the conservation agreements will result in real water savings. Conservation agreements have either been executed or are reasonably foreseeable. As of December 2023, Reclamation has executed contracts for approximately 1.5 million acre-feet of system conservation, and Reclamation is actively working on four additional system conservation agreements to be signed in 2024. Reclamation is therefore confident that the remaining contracts will be executed. Lower Basin States may have their own agreements as to how to implement SEIS conservation and need to be given this flexibility. Reclamation has a strong partnership with the seven Basin States, water users, tribes, and Mexico, and we expect that to continue. This partnership has, among other things, resulted in conservation activities that have added approximately 5.1 million acre-feet to Lake Mead between 2007 and 2022. These types of agreements and partnerships have been effective and Reclamation will continue to utilize them to meet water conservation targets for the duration of the interim period.

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548	5	ALTNODET - Alternatives Not Analyzed In Detail	2.8.2 HYDROPOWER PRIORITIZATION ALTERNATIVE (2-16, 2-17): As CREDA represents the majority of hydropower customers of the CRSP, we have endeavored to understand the specific description of this described alternative that was "considered but eliminated from further consideration". We have been unable to locate the description of a specific proposed alternative that prioritizes "hydropower over all other purposes". On the November 17 webinar re the DSEIS, we asked for specific reference to this alternative, but the response was "to review Chapter 2", which we did before we asked for additional detail. We appreciate the challenge the DSEIS drafters have in reviewing thousands of comments, but in this case, we believe it is important to clarify whether a) a specific "hydropower only" alternative was submitted for consideration and b) if so, how "prioritization" was described as meaning "to the exclusion of all other purposes".	Reclamation received many comments suggesting prioritization of hydropower. These were summarized under the heading of "hydropower prioritization alternative" and discussed under the alternatives considered but eliminated.
636	2	ALTNODET - Alternatives Not Analyzed In Detail	IID also concurs with the elimination of the previous Action Alternative 2 from detailed analysis in the Revised DSEIS because NEPA requires the analysis of alternatives that are feasible. NEPA regulations and judicial authority establish that an alternative that does not comply with the law and/or would result in "protracted debate and litigation" would be infeasible and inadequate for NEPA purposes. (Vermont Yankee Nuclear Power v. NRDC, 435 U.S. 519, 551; 43 C.F.R. § 46.415(b).) Action Alternative 2 was such an alternative; it was not legally viable, it was based on unsubstantiated legal precedent and dubious legal claims, and it violated the Law of the River. As such, Reclamation should also delete the reference in Section 2.4 of the Revised DSEIS that states "The Department may select different parts of any of the (eliminated) alternatives to best meet the Purpose and Need." At minimum, Reclamation must clarify that its authority to implement additional actions are limited to those actions that are authorized under existing legal authorities and do not include elements of Alternative 2 that are not legally defensible because they are not allowed under the Law of the River. The Law of the River is the foundation of all actions, both collaborative and litigious, on the Colorado River. Individuals, families, businesses, farms, cities, agencies, districts, counties and states have relied on the stability and collaboration of the Law of the River in signing contracts, making business decisions, approving investments and making long-term policy decisions. The implementation of the Action Alternative 2 would have laid waste to the Law of the River and would result in immediate litigation that Reclamation would be unable to successfully defend. But of even greater concern to IID is the untimely chaos that would be created in the near-term, when the focus and goal of Reclamation and Colorado River stakeholders should be on seeking collaborative, consensus-based solutions to protect critical reservoir elevations and address supply-demand imbalances to ensure the longer-term viability of the River system.	We have adjusted references to alternatives now described in Section 2.8.10. The Dear Reader Letter to the Revised Draft SEIS described the basis for consideration of the Proposed Action and the basis to move Action Alternatives 1 and 2 into Section 2.8.

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116	1	ALTPROPOSE - Proposed Action Alternative	Despite recent wet conditions, it is important to keep in mind that hydrology is rapidly shifting, the effects of climate change are rampant, and we are likely to see continued decreases in available water supply throughout the Basin. For this reason, the steps outlined in the Lower Division States' third alternative simply may not be enough. As set forth in earlier proposals, the final record of decision should include additional protections for the Basin's water supply and Powell elevations. Specifically, Powell tiers should be adjusted downward, annual releases from Powell should be limited, balancing should be eliminated at certain elevations, and additional steps should be taken to protect Powell.	The hydrologic modeling examines scenarios based on flows in the Basin over the past 30 years (not the 30-year average), which includes the driest 23-year period on record. To examine even worse drought conditions, the hydrologic modeling examines Basin flow scenarios with 90 percent and 80 percent of the flows seen over the past 30 years (up to a 20 percent reduction in flows compared with the last 30 years). The improved hydrology from June 2023 described in the Dear Reader Letter to the Revised Draft SEIS does not indicate a risk of operating Glen Canyon and Hoover Dams in a situation where the inflow minus losses equals outflow, subject to run-of-the-river conditions during the remainder of the interim period, through 2026. Reclamation believes the range of hydrology scenarios analyzed is an appropriate worst case to analyze for conditions that might occur between now and 2026. Additional protections at Lake Powell are included under the Proposed Action.
294	2	ALTPROPOSE - Proposed Action Alternative	The proposed action lacks sufficient safeguards to accommodate uncertainty in achieving the Lower Basin's proposed conservation goals and changes in hydrology. The purpose of the Revised SEIS is to supplement the 2007 Interim Guidelines to modify guidelines for operation of the Glen Canyon and Hoover Dams to address historic drought, historically low reservoirs, and low-runoff conditions in the Basin. The need for the modified operating guidelines is based on the potential that continued low-runoff conditions in the Basin could lead Lake Powell and Lake Mead to decline to critically low elevations, impacting operations through the remainder of the interim period (prior to January 1, 2027). The proposed action should incorporate additional safeguards that would be triggered to adequately protect against unacceptable levels in Lake Powell in the event the Lower Basin fails to secure 3.0 million ac-ft in system conservation, cumulative water conservation activities don't adequately protect the system, and/or Colorado River hydrology is worse than currently predicted.	As of December 2023, Reclamation has executed contracts for approximately 1.55 million acre-feet of system conservation water, and is actively working on additional system conservation agreements to be signed in 2024 which could add approximately 800,000 acre-feet through 2026. The Lower Division States and their partners may also enter agreements to implement SEIS conservation and need to be given this flexibility. For example, the Lower Division States have targeted approximately 600,000 additional acre-feet of conserved water in 2023 that would count as SEIS conservation as described in the DSEIS. Additional safeguards are in place. As noted in Section 2.7, Proposed Action, "Whenever Lake Mead's content is projected to be below an elevation of 1,025 feet, based on the April 24-Month Study minimum probable projection, the Lower Division States, after consultation with the Upper Division States, would have 45 calendar days to provide Reclamation with an implementation plan to protect Lake Mead from reaching an elevation of 1,000 feet. If an implementation plan is not acceptable to Reclamation, then Reclamation may take additional action to protect 1,000 feet." In addition, the ability to reduce Lake Powell releases to 6.0 maf, the Secretary's ongoing reserved authority to take emergency actions, and the SEIS conservation in the Lower Basin states, do show that the system is more protected than under the No Action Alternative.

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294	8	ALTPROPOSE - Proposed Action Alternative	c. Because the proposed action relies on uncertain conservation efforts, and also does not provide adequate measures to protect elevations at Lake Powell if hydrology is similar to 2021 and 2022, the proposed action should include provisions to protect the elevation at Lake Powell if it is in the lowest tier similar to previously proposed Alternatives 1 and 2. Under prior Alternatives 1 and 2, if the elevation at Lake Powell is less than 3,500 ft in any month, the release from Lake Powell can be reduced below 6.0 million ac-ft if necessary to maintain 3,500 ft at the end of the year. In contrast, under the proposed action, if Powell is in the Middle or Lower Tier, a mid-year adjustment could be made to reduce the releases from Lake Powell to no less than 6.0 million ac-ft if the minimum probable scenario in the 24-Month Study results show Lake Powell dropping below 3,500 ft at any point in the following 12 months. The proposed action should be revised to include a provision similar to previously proposed Alternatives 1 and 2 that would allow releases to be reduced below 6.0 million ac-ft to protect elevation 3,500 ft at Lake Powell.	The analysis showed that the Proposed Action balances risks between Lake Powell and Lake Mead better than the operational tiers considered in Action Alternatives 1 and 2, as demonstrated in the graph on p. 2 of the Dear Reader Letter to the Revised Draft SEIS. Action Alternatives 1 and 2 were therefore moved to the alternatives considered but eliminated from detailed analysis section. In addition, the ability to reduce Lake Powell releases to 6.0 maf, the Secretary's ongoing reserved authority to take emergency actions, and the SEIS conservation in the Lower Basin states, do show that the system is more protected than under the No Action Alternative as well as Action Alternatives 1 and 2 from the Original Draft SEIS.
294	10	ALTPROPOSE - Proposed Action Alternative	a. The proposed action assumes that it will be possible for the Lower Basin to secure 3.0 million ac-ft in system conservation, creation of ICS, or other water conservation activities that result in system benefits, as outlined in the Lower Basin proposal. However, this action is highly contingent and rests on uncertain outcomes, creating a high degree of risk that the proposed action will fail to meet the purpose and need.	The reductions are not speculative. Conservation agreements have either been executed or are reasonably foreseeable. As of December 2023, Reclamation has executed contracts for approximately 1.55 million acre-feet of system conservation water, and is actively working on additional system conservation agreements to be signed in 2024 which could add approximately 800,000 acre-feet through 2026. The Lower Division States and their partners may also enter agreements to implement SEIS conservation and need to be given this flexibility. For example, the Lower Division States have targeted approximately 600,000 additional acre-feet of conserved water in 2023 that would count as SEIS conservation as described in the DSEIS. Reclamation has a strong partnership with the seven Basin States, water users, tribes, and Mexico, and we expect that to continue. This partnership has, among other things, resulted in conservation activities that have added approximately 5.1 million acre-feet to Lake Mead between 2007 and 2022. These types of agreements and partnerships have been effective and Reclamation will continue to utilize them to meet water conservation targets for the duration of the interim period.

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295	1	ALTPROPOSE - Proposed Action Alternative	We are disappointed that the draft SEIS identifies the Lower Colorado Basin states' proposal to add an additional 750k AFY of conservation on top of the existing 2007 agreements and the 2019 Drought Contingency Plan requirements as the preferred US Bureau of Reclamation (USBR) alternative for near-term operations. This is a major change/volume reduction from the previous draft that recommended two 2.083M AFY alternatives. The current recommendations at the existing Lake Mead water level are nearly one million AFY less the pervious recommendations. In addition, the preferred alternative is substantially less than the 1.5M AFY proposal made by the six upstream states in the Colorado River Basin.	Action Alternatives 1 and 2 were considered in the original Draft SEIS but were ultimately dismissed from detailed analysis in the revised Draft SEIS because their performance was similar to or worse than the Lower Division proposal (now the Proposed Action) as explained in the Dear Reader Letter to the Revised Draft SEIS and Section 2.8. Reclamation analyzed the Lower Division Proposal (now the Proposed Action) at the request of the Seven Basin States, and that analysis shows that the Proposed Action balances the risk between Lake Mead and Lake Powell better than the alternatives considered in the Original Draft SEIS. The current range of alternatives thus meets the purpose and need to address low reservoir conditions across the Basin in the short term and, perhaps more importantly, provides the space "so that all parties can focus their resources on the development of the post-2026 guidelines" as described by the Seven Basin States. Reclamation modeled the 6-state proposal along with others received in Appendix B of the Original Draft SEIS. These proposals were similar to the actions considered in Action Alternatives 1 and 2 in the original Draft SEIS and are similarly affected by the improved June 2023 hydrology. Reclamation is not remodeling these proposals or comparing them against the Proposed Action for the same reasons that Action Alternatives 1 and 2 have been eliminated (see the Dear Reader Letter and Section 2.8.10).
295	9	ALTPROPOSE - Proposed Action Alternative	As a reminder, the six upper Colorado Basin states made a recommendation for 1.5m AFY reductions just one year ago. The preferred alternative is roughly 500K AFY less in water use reductions than that proposal at the current Lake Mead height of 1,066 feet. Lake Mead, over the first 23 years of the century dropped an astounding 150 feet. USBR's current recommended approach to Lake Mead management is for the 750k AFY reductions from the three Lower Basin states to be added to the 2007 and 2019 DCP reduction requirements with a panic lake level at 1,000 feet above sea level. That's a peak of about 1.875m AFY of water allocations, still below the previous dSEIS's preferred 2.083m AFY scenarios.	Action Alternatives 1 and 2 were considered in the original Draft SEIS but were ultimately dismissed from detailed analysis in the revised Draft SEIS because their performance was similar to or worse than the Lower Division proposal (now the Proposed Action) as explained in the Dear Reader Letter and Section 2.8. As explained in the Dear Reader Letter to the revised Draft SEIS, Reclamation analyzed the Lower Division Proposal (now the Proposed Action) at the request of the Seven Basin States, and that analysis shows that the Proposed Action balances the risk between Lake Mead and Lake Powell better than the alternatives considered in the Original Draft SEIS. The current range of alternatives thus meets the purpose and need to address low reservoir conditions across the Basin in the short term and, perhaps more importantly, provides the space "so that all parties can focus their resources on the development of the post-2026 guidelines" as described by the Seven Basin States. Reclamation modeled the 6-state proposal along with others received in Appendix B of the Original Draft SEIS. These proposals were similar to the actions considered in Action Alternatives 1 and 2 in the original Draft SEIS and are similarly affected by the improved June 2023 hydrology. Reclamation is not remodeling these proposals or comparing them against the Proposed Action for the same reasons that Action Alternatives 1 and 2 have been eliminated (see the Dear Reader Letter and Section 2.8.10).
295	13	ALTPROPOSE - Proposed Action Alternative	Allocation of water management funding through IRA and other federal assistance must be for measures with permanent conservation benefits Despite the additional time extension to incorporate the Lower Basin states' modest 750K AFY reduction proposal, the SEIS did not include an analysis or recommendations on how to best use the $4 billion plus in federal funds to reduce Colorado River water consumption in the basin. NRDC strongly recommends that this analysis be added to the SEIS and that USBR and the President Biden administration allocate those resources in a way that will achieve permanent conservation benefits in an equitable manner.	Reclamation continues to work on these issues; however, they are not within scope of this SEIS.

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295	15	ALTPROPOSE - Proposed Action Alternative	All SEIS alternatives' analyses should include more rigorous application of the Bureau's authority under 43 CFR Part 417 to reduce a contractor's water order for delivery from the Lower Colorado River to the amount that ensures the beneficial use of all water so withdrawn. Part 417 specifies that each year's water order shall be evaluated by the Bureau taking into account several specific factors, including a contractor's land classifications, the kinds of crops raised, the type of irrigation systems in use, the condition of distribution facilities, and the operating efficiencies of the water users. Excessive water duty, antiquated distribution systems, promotional water pricing, and injudicious crop selection can all contribute to excessive water use that should no longer be accommodated.	Any evaluation of provisions related to Part 417 beneficial use is an independent process to ongoing NEPA activities in the lower Colorado River basin.
296	2	ALTPROPOSE - Proposed Action Alternative	We also ask that the final EIS describe the measures Reclamation anticipates taking to conserve three million-acre feet of water under the Lower Division Proposal. The environmental impacts of the Lower Division Proposal depend largely on how conservation will be achieved. If conservation will be achieved by fallowing large areas of agricultural land, for example, the EIS must consider the impacts of the fallowing, including air quality impacts from dust, impacts to special status species that rely on irrigated farmland for habitat, etc. The draft EIS provides no information about these impacts, instead noting in a footnote that these measures "would be subject to additional environmental compliance, as appropriate." RSEIS at 2-7, fn. 4. Deferring this analysis until after Reclamation approves the Lower Division Proposal does not satisfy NEPA's fundamental informational purpose. Friends of the Earth, Inc. v. Coleman, 518 F.2d 323, 327 (9th Cir. 1975) (EIS "should be prepared at the earliest time prior to implementation of the proposed action, so that alternative courses of action with less severe environmental consequences can be considered"), abrogated on other grounds by Cottonwood Envtl. Law Center v. U.S. Forest Serv., 789 F.3d 1075 (9th Cir. 2015).	This SEIS is analyzing impacts at the point of delivery. Not all system conservation agreements will result in following. Reclamation is not imposing fallowing measures on any water district or tribe. These entities are voluntarily entering into these agreements, and Reclamation does not know how exactly entities will engage in conservation measures. Analysis of specific types of measures would be too speculative. Individual conservation agreements, when they have more detail, will be subject to separate NEPA analysis.
300	1	ALTPROPOSE - Proposed Action Alternative	As described in the previously released DSEIS, the Lower Basin water use reductions were to be "mandatory, enforceable, measurable, verifiable, and non-retrievable." The Revised Draft SEIS does not clearly nor sufficiently define the timing, amount by source and/or accounting methods of the proposed lower basin conservation measures. Beyond the requirement of a minimum of 1.5 MAF compensated water conservation by the end of operating year 2024, as described in the proposed action alternative, there is no written requirement to implement additional steps to reduce Lower Basin water use. Furthermore, the Revised Draft SEIS fails to differentiate the type of conservation volumes between conservation that accrues to the system (and is thus non-retrievable by a specific party) versus Intentionally Created Surplus (ICS) which can be retrieved and delivered at a later date (thus, simply delaying the depletion to the system instead of creating saved water). In order to provide new benefits to the system, the Lower Basin water use reductions incorporated into the preferred Action Alternative should be achieved through new, additional, and verifiable conservation projects that must be accounted for separately from any conservation measures that already are in place pursuant to the existing 2007 Interim Guidelines, the 2019 Drought Contingency Plan, or other existing pledges of conservation.	The reductions are new, additional, and verifiable. Conservation agreements have either been executed or are reasonably foreseeable. As of December 2023, Reclamation has executed contracts for approximately 1.55 million acre-feet of system conservation water, and is actively working on additional system conservation agreements to be signed in 2024 which could add approximately 800,000 acre-feet through 2026. The Lower Division States and their partners may also enter agreements to implement SEIS conservation and need to be given this flexibility. For example, the Lower Division States have targeted approximately 600,000 additional acre-feet of conserved water in 2023 that would count as SEIS conservation as described in the DSEIS. Reclamation has a strong partnership with the seven Basin States, water users, tribes, and Mexico, and we expect that to continue. This partnership has, among other things, resulted in conservation activities that have added approximately 5.1 million acre-feet to Lake Mead between 2007 and 2022. These types of agreements and partnerships have been effective and Reclamation will continue to utilize them to meet water conservation targets for the duration of the interim period.

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300	4	ALTPROPOSE - Proposed Action Alternative	2.) Operational Tiers and reduced annual release volumes (i.e., 6.0 million acre-feet/year) The Revised Draft SEIS fundamentally changes the operational approach described in the original DSEIS. The Colorado River District believes that operational approach from the original DSEIS should remain in the SEIS, so that when Lake Powell is at or below elevation 3,575, releases are set at 6.0MAF, with adjustments related to April 24 month projections necessary to meet end-of-water-year levels of 3,575' or greater. We share the concerns expressed by the UCRC that the revised Proposed Action Alternative reverts to the traditional operational tiers, associated with the 2007 Interim guidelines that have not adequately protected the system. The revised Proposed Action Alternative no longer affords Reclamation the tools it needs to adequately protect federal infrastructure at Lake Powell	The Proposed Action does meet the purpose of and need for the SEIS to address low reservoir conditions at Lake Powell and Lake Mead. Analysis of the Proposed Action was supported by the seven Basin States, and the analysis showed that the Proposed Action balances risks between Lake Powell and Lake Mead better than the operational tiers considered in Action Alternatives 1 and 2, as demonstrated in the graph on page 2 of the Dear Reader Letter to the Revised Draft SEIS. Action Alternatives 1 and 2 were therefore moved to the alternatives considered but eliminated from detailed analysis section. In addition, the ability to reduce Lake Powell releases to 6.0 maf, the Secretary's ongoing reserved authority to take emergency actions, and the SEIS conservation in the Lower Basin states, do show that the system is more protected than under the No Action Alternative as well as Action Alternatives 1 and 2 from the Original Draft SEIS.
301	4	ALTPROPOSE - Proposed Action Alternative	Protection of Critical Elevations. Establishing protection elevations in Lake Mead and Lake Powell should continue to be a critical component of reservoir operations or emergency actions to protect infrastructure, water deliveries, and hydropower generation. Protecting Lake Mead at 1,000' and Lake Powell at 3,500,' as described in the Lower Basin Proposal and included in the SEIS proposed alternative, will reduce risks to water and hydropower customers over the long term.	Thank you for your comment.
302	2	ALTPROPOSE - Proposed Action Alternative	The states then presented a new and slightly improved shortage agreement. This three-year agreement does not match the minimal target range of about 15%. To see actual improvement in the basin, reductions must to be 20% and in this decade. In the next decade the target must be 25%. If this target cannot be matched for the SEIS, then we can safely assume it won't be matched in the final EIS for the new guidelines of 2026.	The reference to the target range in this comment is unclear, and it is not clear how the comment relates to the purpose of and need for, or scope of, this SEIS.
308	1	ALTPROPOSE - Proposed Action Alternative	The Revised Draft SEIS fails to include adequate and meaningful discussion of the environmental effects that either of the two alternatives will have on communities that rely entirely or almost entirely on fourth priority water entitlements and the catastrophic devastation that will result. The Revised Draft SEIS fails to include any alternative that will provide water to communities that rely entirely or almost entirely on fourth priority entitlements so those communities will not perish. The Revised Draft SEIS fails to include any discussion of mitigation measures that could save these communities from obliteration under each of the alternatives.	Thank you for your comment. Reclamation prepared this SEIS to analyze the potential environmental effects of the proposed action. Reclamation has taken a hard look at the Proposed Action and analyzed the environmental effects. Chapter 3.7 of the SEIS analyzes impacts to water deliveries. As described in Section 3.3, a Shortage Allocation Model was used in addition to the CRMMS to analyze the potential impacts of the alternatives on individual water users within each Lower Division State. The Shortage Allocation Model was used to estimate delivery of water to Colorado River water users within the Lower Division States under varying levels of shortage. Under the volumes of shortage modeled in this SEIS in accordance with existing commitments and modeling assumptions, the communities relying on Arizona P4(i) water supplies are estimated to face shortages of up to 40% of their entitlements, or 18,520 acre-feet per year in total under certain conditions, but not a full reduction.

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308	3	ALTPROPOSE - Proposed Action Alternative	The new Proposed Action consists largely of compensated System Conservation that would not be a sustainable option for the state of Arizona and the communities that rely entirely on the River as their source of water. BOR claims that, due to improved hydrology, it appears much less likely that either reservoir will drop to critical elevations through 2026. Yet, the Proposed Action, similar to the No Action Alternative, calls for a mid-year review and adjustment in the event that" Lake Mead' s content is projected to be below an elevation of 1, 025 feet, based on the April 24- Month Study minimum probable projection." Revised Draft SEIS, Section 2- 7. In such circumstances, the Lower Division States would first consult with the Upper Division States and " would have 45 calendar days to provide Reclamation with an implementation plan to protect Lake Mead from reaching an elevation of 1, 000 feet. If an implementation plan is not acceptable to Reclamation, then Reclamation may take additional action to protect 1, 000 feet." Id. This leaves significant uncertainty for Arizona fourth priority entitlement holders who will absorb the brunt of any further shortage. Additionally, this would not be an equitable distribution of the impacts of shortages, nor would this approach be a sustainable or viable option for the on- river communities.	The Secretary retains the authority to protect the Colorado River system if hydrologic conditions require additional action. This SEIS does not project or limit what those additional actions may be, and does not foreclose Reclamation conducting necessary additional environmental compliance. In hydrologic modeling for the Revised DSEIS, only 2% of traces for the Proposed Action fall below 1,000'.
308	9	ALTPROPOSE - Proposed Action Alternative	The final SEIS must consider additional (or modified) alternatives or further details to the Proposed Action to avoid potential environmental devastation related to public health and safety of communities whose only source of water is fourth priority entitlements. The final SEIS must provide assurance that these communities may pump an amount of water necessary to allow them to survive, regardless of shortage level. By example, California statute contains an allowance for communities to appropriate 55 gallons per capita per day " notwithstanding curtailment of that right" for public health and safety reason, allowing those communities to continue to exist. Cal. Code Regs. Tit. 23 SS 878. 1(b); see also Cal. Wat. Code SS10608. 20(b)(2)(A) (setting provisional indoor residential water use standard at 55 gallons per day per capita).	Thank you for your comment. Reclamation prepared this SEIS to analyze the potential environmental effects of the proposed action. Reclamation has taken a hard look at the Proposed Action and analyzed the environmental effects. Chapter 3.7 of the SEIS analyzes impacts to water deliveries. As described in Section 3.3, a Shortage Allocation Model was used in addition to the CRMMS to analyze the potential impacts of the alternatives on individual water users within each Lower Division State. The Shortage Allocation Model was used to estimate delivery of water to Colorado River water users within the Lower Division States under varying levels of shortage. For all operations, the Secretary reserves the right to operate Reclamation facilities to address extraordinary circumstances, as described in Section 7(D) of the 2007 Interim Guidelines, including “operations that are prudent or necessary for safety of dams, public health and safety, other emergency situations, or other unanticipated or unforeseen activities arising from actual operating experience.”

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310	23	ALTPROPOSE - Proposed Action Alternative	The worst-case scenario for drought is defined by the RDSEIS as 80% or 90% of the 30-year average (Sections 2.8.7 and 3.3.3). The assumption does not reflect the reality of the Colorado River flow. The 10-year running mean is most recently 12 Maf or approximately 80% of the running mean (a proxy for the 30-year average that is used; see fig 3-1) or 75% of the most recent 10 year running mean. With the residence time of water in this reservoir system being on the order of 2-3 years, the 10-year running mean is a more appropriate starting point and is yet still biased towards higher flow regimes. Furthermore, the flow of the river during drought has most recently been on the order of 8-10 Maf (60% of the 30-year mean flow or 75% of the 10-year running average flow. Thus, we find that the "worst-case scenario" (section 2.8.7) does not reflect a true and possible worst-case scenario. A more appropriate "worst-case scenario" would be 8-10 Maf, 60% of mean flow or 75% of the current 10-year running average. We are dealing with the probabilities of future precipitation and runoff which might best be evaluated from mid-year assessment of snowpack. It is concluded, therefore, that the "worst-case scenario" analysis is flawed (section 2.8.7), and the river operating system should most definitely be reconsidered with a mid-term review with defined contingencies should 2024 end as a typical drought year for the Basin rather than an average year. Recommendation 3: The Near-term Colorado River Operations (2024-2026) must require flows to be released from Glen Canyon Dam only when sediment levels are adequate, optimizing sediment retention in the Grand Canyon.	The hydrologic modeling examines scenarios based on flows in the Basin over the past 30 years (not the 30-year average), which includes the driest 23-year period on record. To examine even worse drought conditions, the hydrologic modeling examines Basin flow scenarios with 90 percent and 80 percent of the flows seen over the past 30 years (up to a 20 percent reduction in flows compared with the last 30 years). The improved hydrology from June 2023 described in the Dear Reader Letter to the Revised Draft SEIS does not indicate a risk of operating Glen Canyon and Hoover Dams in a situation where the inflow minus losses equals outflow, subject to run-of-the-river conditions during the remainder of the interim period, through 2026. Reclamation believes the range of hydrology scenarios analyzed is an appropriate worst case to analyze for conditions that might occur between now and 2026. Reclamation has the ability to adjust operations based on additional data as they become available (for example, the 24-month study). In the Proposed Action, additional tools to lower releases based on minimum probable scenarios are available.

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320	2	ALTPROPOSE - Proposed Action Alternative	While the Proposed Action Alternative, if adopted, would provide further protections against such risk, the system conservation effort you launched to allow the Lower Basin entities to step up with substantial commitments for long-term system conservation, such as ours, will serve us in good stead regardless of whether the Proposed Action Alternative is now adopted or not. Thus, the Community has no strong position about whether to adopt the Proposed Action Alternative or the No Action Alternative. As we have pointed out in the past, it will be prudent for Reclamation to await some preliminary data about precipitation and runoff this spring before taking any action on the Revised Draft SEIS. This has been a consistent theme of our comments to date and we are pleased to see that Reclamation has slowed down this process in a manner that will take this new data into account. This is not to say that Reclamation should not take action on the Revised Draft SEIS. Rather, we are simply urging you to wait until the end of the first quarter in 2024 when the precipitation and runoff indications for the coming year will be more accurate and base your final decision on that data. The Community looks forward to supporting Reclamation as it continues to consider the No Action and Proposed Action Alternatives in the SEIS process. In the interim, we strongly urge Reclamation to keep its focus on making decisions about long-term system efficiency investments through your "Bucket 2" program. As you know, there are a number of very important investments that can be made for projects that will have a nearly immediate impact on system efficiency, including our own. Having the benefit of those projects in place even before the end of the Post-2026 negotiation period would be highly beneficial to the overall negotiation environment. As part of your Bucket 2 deliberations, we also urge you to pay particular attention to projects that could develop new water supplies to replace anticipated reductions to Lower Basin entitlements. There are many viable projects for new water supplies in Arizona that could have a significant impact on our State's current dependence on the Colorado River, especially for CAP Tribes like ours, and we look forward to engaging in more detailed discussions with you on that topic in the coming weeks and months.	The current forecasts project flows within the range of the projections presented in the Dear Reader Letter to the Final SEIS (see new figure). Delaying the analysis until the end of the first quarter of 2024 would delay the record of decision and would not allow Reclamation to have necessary operational tools in place to operate Lake Powell in Water Year 2024.
410	1	ALTPROPOSE - Proposed Action Alternative	Reclamation projects that the implementation of the Proposed Action will reduce the risk of lower elevations at Lake Mead, thereby resulting in a lower likelihood of severe shortages and comparable reductions to Central Arizona Project (CAP) deliveries, which would in turn preserve the Nation's CAP entitlement to a greater extent than the No Action Alternative. In this way, the Proposed Action also constitutes a marked improvement over Alternatives 1 and 2 in the now withdrawn draft SEIS.	Thank you for your comment.

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410	9	ALTPROPOSE - Proposed Action Alternative	the Shortage Sharing Criteria in the Nation's SAWRSA settlement,46 contemplate shortage-based reductions occurring under anything other than an annual basis. While the Secretary retains authority under the Long-Range Operating Criteria to revise Interior's annual operating plans to account for "current hydrologic conditions" Interior may not use the SEIS process to expand this authority beyond its limited scope. The Proposed Action instead contemplates revisions to the Guidelines to allow the exercise of Secretarial authority to protect Lake Mead from reaching an elevation of 1,000 feet and protecting Lake Powell from dropping below an elevation of 3,500 feet.47 For Lake Powell, these revisions allow for Reclamation to impose mid-year adjustments to reduce annual releases to no less than 6.0 maf if the minimum probable scenario in any 24-Month Study shows the reservoir dropping below 3,500 feet at any point in the subsequent 12 months.48 For Lake Mead, these revisions contemplate the development of an implementation plan on the part of the Lower Division States (after consultation with the Upper Division States) to protect an elevation of 1,000 feet in the event that a minimum probable scenario in any 24-Month Study projects elevations below 1,025 feet, with Reclamation ultimately authorized to take unspecified actions in the event that it does not agree with the plan.49	Comment noted.
484	4	ALTPROPOSE - Proposed Action Alternative	2. Operational Tiers The First Draft SEIS modified the operational tiers of the 2007 Interim Guidelines to change operations at lower reservoir elevations. Specifically, the First Draft SEIS removed balancing when Lake Powell was below elevation 3,575 feet, and provided set releases of 6.0 maf with adjustments made, if necessary, in light of the April projections for end-of-wateryear levels. However, the Revised Draft SEIS reverts back to the current 2007 Interim Guidelines operational tiers, maintains balancing at lower Lake Powell elevations, and provides for a reduction of releases from Lake Powell down to a minimum of 6.0 maf to maintain elevation 3,500 feet. The Revised Draft SEIS changes the approach from a set 6.0 maf release from Lake Powell to a potential 6.0 maf schedule. The UCRC is concerned that the Proposed Action Alternative does not meet the purpose and need because it reverts to the operational tiers and opportunities for balancing which do not adequately protect the system or offer Reclamation the tools it seeks to obtain through this SEIS. Accordingly, the UCRC requests that, in the Final SEIS, Reclamation reinstate the modifications to the operational tiers identified in the First Draft SEIS.	The Proposed Action does meet the purpose of and need for the SEIS to address low reservoir conditions at Lake Powell and Lake Mead. Analysis of the Proposed Action was supported by the seven Basin States, and the analysis showed that the Proposed Action balances risks between Lake Powell and Lake Mead better than the operational tiers considered in Action Alternatives 1 and 2, as demonstrated in the graph on p. 2 of the Dear Reader Letter to the Revised Draft SEIS. Action Alternatives 1 and 2 were therefore moved to the alternatives considered but eliminated from detailed analysis section. In addition, the ability to reduce Lake Powell releases to 6.0 maf, the Secretary's ongoing reserved authority to take emergency actions, and the SEIS conservation in the Lower Basin states, do show that the system is more protected than under the No Action Alternative as well as Action Alternatives 1 and 2 from the Original Draft SEIS.
484	11	ALTPROPOSE - Proposed Action Alternative	Moreover, the process by which the 3.0 maf in additional reductions will be measured and accounted for is unclear at this point. The Revised Draft SEIS does not specify what portion of the Proposed Action Alternative, if any, may be achieved through ICS creation or ICS conversion. ICS conversion will provide no additional wet water benefit to the system and does not address the purpose and need of the SEIS. The 3.0 maf of reductions through 2026 should be achieved through new, additional, and verifiable conservation projects. Further, these reductions should be accounted for separately from any ICS conversion activities to ensure wet water conservation is in fact achieved.	No ICS conversion is counted toward the 3.0 maf of SEIS conservation. Conservation agreements have either been executed or are reasonably foreseeable. As of December 2023, Reclamation has executed contracts for 1,537,668 acre-feet of system conservation, and Reclamation is actively working on four additional system conservation agreements to be signed in 2024. Reclamation has always made its data and accounting available. It is the same type of accounting that has been done for decades, pursuant to the Supreme Court Decree, and the same type of accounting done since 2007. It is publicly available and transparent, and Reclamation has offered to provide technical assistance to increase understanding.

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484	12	ALTPROPOSE - Proposed Action Alternative	3. Protection of Lake Powell In its "Dear Reader Letter," Reclamation acknowledges that the alternatives in the First Draft SEIS are more protective of Lake Powell than the current Proposed Action.3 [See comment letter for footnote] Reclamation also asserts that the SEIS should include cautious approaches to protecting critical elevations. It is therefore our expectation that the Final SEIS will be equally protective of Lake Powell as were the other alternatives analyzed during the SEIS process, as described above.	It is Reclamation's view that the Proposed Action, as demonstrated in the Dear Reader Letter to the Revised Draft SEIS (p.2), balances risks between Lake Powell and Lake Mead better than the operational tiers considered in Action Alternatives 1 and 2, even if there are slight increases in risk of Lake Powell reaching critical elevations.
548	2	ALTPROPOSE - Proposed Action Alternative	1.2 PROPOSED FEDERAL ACTION (1-9): The information contained in footnote 9 should be brought into the body of this section, and not relegated to a footnote. This text is one of the first references to the hydropower purpose (in reference to "infrastructure") and underscores an important fact: the hydropower purpose of the Colorado River Storage Project (CRSP), and specifically Glen Canyon Dam in this DSEIS, is inseparable from water delivery changes and conditions. It is incorrect that only "in recent months" has Reclamation become concerned about protecting reservoir elevations for authorized purposes. Reclamation is the second largest producer of hydropower in the United States, and direct and indirect impacts to all aspects of this carbon-free life-essential resource must be identified, analyzed and mitigated. The Proposed Action should clearly state that reference to "infrastructure" relates to the water AND POWER purposes of Reclamation's statutory obligations and mission.	"In recent months" has been edited. Placement in a footnote is appropriate for the technical content of this material, the reference to infrastructure, as currently drafted, is intended to capture the range of authorized purposes for Glen Canyon Dam.
555	2	ALTPROPOSE - Proposed Action Alternative	The Lower Basin's Proposed Alternative is a positive step, but a provision that conservation in 2026 be eliminated if there is significant snowpack in 2024 and 2025 should be included.	Terms of conservation are agreed to in a system conservation implementation agreement (SCIA) with individual water entitlement holders. The terms of a SCIA are specific to each contract and are not dictated by the outcome of this SEIS. Other types of SEIS conservation such as Intentionally Created Surplus are at the discretion of the water entitlement holder creating the ICS.
555	5	ALTPROPOSE - Proposed Action Alternative	If Lake Powell is in the Lower Elevation Balancing Tier (3525'-3370'), can the system infrastructure at Glen Canyon Dam accommodate the 7.0-9.5 MAF release requirements? * How does this reconcile with the 6.0 MAF release if Lake Powell goes below 3,500'? * The critical elevation at Lake Mead appears to be referenced both as 1,000' and 1020' in the report, which is it?	Thanks for your questions. Per the 2007 Interim Guidelines, Lake Powell annual releases in the Lower Elevation Balancing Tier can range from 7.0 to 9.5 maf. Through the SEIS, the Proposed Action would allow releases down to 6.0 maf to protect 3,500'. If the Proposed Action was chosen as the preferred alternative, the Record of Decision would be updated to allow releases of 6.0 maf from Lake Powell to protect 3,500'. Different elevations at Lake Mead have significance based on different agreements. The elevation of 1,020 feet was identified as a critical protection elevation in the 2019 DCPs. The elevation of 1,000' was identified in the Lower Division State Proposal as the elevation to protect.
555	9	ALTPROPOSE - Proposed Action Alternative	Why does the "Proposed Alternative" indicate that more than 1.5 MAF will be delivered to Mexico in 2026?	There is a maximum delivery to Mexico of 1.5 maf, but no instance of volumes greater than this. Figure 3-24 shows the range of deliveries for the different alternatives. The figure shows that only a few outlier traces have deliveries to Mexico of 1.5 maf in 2025 and 2026. 95% of traces or greater have deliveries to Mexico below 1.5 maf.

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295	8	APRILDSEIS - April Draft SEIS	The previous SEIS included extensive analyses of two alternatives that would have resulted in a reduction of just over 2M AFY. The explanation for elimination of these alternatives was inadequate and largely relied on the fact that the Colorado River Basin had an above average precipitation year. One good precipitation year is not enough to eliminate those two reasonable alternatives. NRDC understands why a three or four million acre-foot per year reduction scenario wasn't included in the SEIS in light of the good year, but the extensive analyses on the 2M AFY alternatives should be retained and seriously considered in USBR's final near-term operations decisions.	Action Alternatives 1 and 2 were considered in the original Draft SEIS but were ultimately dismissed from detailed analysis in the revised Draft SEIS because their performance was similar to or worse than the Lower Division proposal (now the Proposed Action) as explained in the Dear Reader Letter and Section 2.8. As explained in the Dear Reader Letter to the revised Draft SEIS, Reclamation analyzed the Lower Division Proposal (now the Proposed Action) at the request of the Seven Basin States, and that analysis shows that the Proposed Action balances the risk between Lake Mead and Lake Powell better than the alternatives considered in the Original Draft SEIS. The current range of alternatives thus meets the purpose and need to address low reservoir conditions across the Basin in the short term and, perhaps more importantly, provides the space “so that all parties can focus their resources on the development of the post-2026 guidelines” as described by the Seven Basin States.
555	1	APRILDSEIS - April Draft SEIS	The Bureau of Reclamation's withdrawal of the Draft SEIS and revision based on the Lower Basin States' proposal and the revised hydrology is appreciated. The previous alternatives presented in the April SEIS were too narrow in scope to support, and the inequity between the Upper and Lower Basin states regarding conservation measures was alarming.	Noted.
297	19	CONSBIO - Consultation and Coordination BIO	Reclamation must plan and manage for Endangered Species Act compliance not just in Grand Canyon national park, but for Glen Canyon National Recreation Area. This EIS relies on minimal species monitoring in the "restoration zone" of GCNRA (above reservoir level and below 3,700), but the extensive emerging ecosystems could provide habitat for threatened and endangered species. This is something that was alluded to in the Draft SEIS30, which stated, "Declining reservoir elevations in Lake Powell and Lake Mead have exposed deltaic sediments through which the Colorado River has carved a new channel. In Lake Powell, new channels 'each about 30 miles long ' have formed in the Colorado River and the San Juan River inflow. Razorback sucker and a few Colorado pikeminnow have been detected in these inflow areas." But the analysis of biological resources mentions nothing about monitoring of the fauna inhabiting Glen Canyon's restoration areas, like birds, beaver, deer, and bighorn sheep.	Thank you for your comment. Reclamation is engaging in ongoing consultation with USFWS regarding ESA compliance and will continue to do so into the future. Any monitoring requirements the USFWS will require will emerge from that consultation process.
310	11	CONSBIO - Consultation and Coordination BIO	The RDSEIS (p. 3-183) states, "Information pertaining to Endangered Species Act (ESA)-listed species is still being drafted in the biological assessments. Updated information will be incorporated into the final SEIS when it is available." This is putting the cart before the horse. The biological assessment from the Fish & Wildlife Service (FWS) should be included as part of any Draft SEIS. Otherwise, how are we to know from the proper authority (FWS) to what degree ESA species are impacted? The degree to which they are impacted determines whether mitigation is required. If mitigation is not feasible, what will Reclamation do to compensate for the loss of ESA-listed and other special status species? And will lack of mitigation put them in greater jeopardy? We don't know because we don't have the biological assessment. The opportunity to comment when the Final SEIS is released is much more limited than for the Draft, so the biological assessment needs to be appended to the draft NEPA document.	Biological assessments have been submitted to USFWS and consultation is on-going. ESA species are addressed in the biological assessment and will addressed in the biological opinion. Avoidance, minimization, and mitigation measures are outlined in the biological assessment and biological opinion. This information will be referenced in the FSEIS.

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326	5	CONSBIO - Consultation and Coordination BIO	Four Service National Wildlife Refuges (NWRs) are located directly along the lower Colorado River (Havasu NWR, Bill Williams NWR, Cibola NWR, and Imperial NWR), and a fifth, Sonny Bono Salton Sea NWR, is connected to the lower Colorado River through water deliveries by the Imperial Irrigation District and Coachella Valley Water District. Each NWR was established by Congress for a designated purpose and shall be managed to fulfill the purpose under the legal authority of the establishing statutes. These refuges are dependent on water that passes through and that is diverted from the Colorado River. The four NWRs in Arizona serve as integral components of the LCR MSCP. The Service is concerned with downstream effects to the NWRs and backwater habitat due to the changes in releases resulting from alternatives being considered. The Service requests information on the projected minimum releases for the alternatives, including flow rate, seasonal timing, duration, and related river stage elevation decreases. This information will allow the Service as a downstream water user to quantify effects from decreased river flows, especially downstream of Lake Mead.	The 2007 FEIS did not look at monthly or hourly flow rates for reservoir releases downstream of Hoover Dam; therefore it is out of scope of this supplemental EIS since monthly and hourly release patterns will not be modified. Releases out of Hoover Dam are driven by water orders and any requirements of the Multi-Species Conservation Program (MSCP) and as such are not modeled at monthly intervals at this time. Monthly and sub-annual flow rates will be analyzed separately in the LCR MSCP and a Biological Assessment with the USFWS. Moreover, the Proposed Action relies on voluntary conservation designed to increase Lake Mead elevations, and higher Lake Mead elevations will provide more certainty for Refuges concerning water availability.
326	17	CONSBIO - Consultation and Coordination BIO	[Section 1.4 page 1-11] Please review paragraph on the Service. Either revise sentence concerning the number of refuges managed to include the three along the green river (e.g. Seedskadee; Browns Park; Ouray) and Sonny Bono Salton Sea OR revise the sentence to state that there are 4 refuges along the Lower Colorado River.	Change "The Service manages the resources within four national wildlife refuges along the Colorado River." to "The Service manages numerous facilities related to the Colorado River, including four national wildlife refuges along the lower Colorado River."
326	25	CONSBIO - Consultation and Coordination BIO	[Table 3.25, page 3-175] The table doesn't identify the status of four species. Please add this information.	Status updated
326	26	CONSBIO - Consultation and Coordination BIO	[Table 3-25 page 3-175] The table identifies woundfin as a non-ESA listed species, but this species is ESA listed and should be moved to Table 3-24.	Change made
326	28	CONSBIO - Consultation and Coordination BIO	[Section 3.13.1, page 3-184] "Impacts on these species will be captured through the analysis of BLM sensitive species that use the same habitat types in the Glen Canyon Dam to Lake Mead sections." How is the reader supposed to know what the effects are on the GCNP special-status species? The text infers that the effects to GCNP species would be the same as for BLM species that use the same habitat. But nowhere does the document identify what type of habitats the GCNP species use. In the "environmental consequences" section, it would be simpler to just list the GCNP species and the alternatives' effects on them. It would also make sense to add these species to Table 3-25 (non-listed species in the affected area).	Reclamation developed a species list that is consistent across the entire project area. To do this, Reclamation based the list on BLM sensitive species within a set buffer of the river corridor. This is a comprehensive list and is included in the affected environment discussion in Section 3.13.1 of the SEIS. The comprehensive table in Appendix G has a column noting whether the species is likely to be affected by the alternatives. Only those with yes are discussed in environmental consequences, Section 3.13.2. Section 3.13.1 also notes that NPS is concerned about additional species that are not BLM sensitive. Impacts on those species that NPS is concerned about are captured through analysis of BLM sensitive species. This is because impacts on wildlife are based on the impacts on the type of habitat they use, as detailed in the vegetation section. Added clarifying text linking the specific NPS species of concern to their habitat types.

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326	30	CONSBIO - Consultation and Coordination BIO	[Section 3.13.1, page 3-185] "Impacts on these [LCR MSCP] species will be captured through the analysis of BLM sensitive species that use the same habitat types in the Hoover Dam to the SIB section." How is the reader supposed to know what the effects are on the LCR MSCP species? The text infers that the effects to LCR MSCP species would be the same as for BLM species that use the same habitat. But nowhere does the document identify what type of habitats the GCNP species use. In the "environmental consequences" section, it would be simpler to just list the LCR MSCP species and the alternatives' effects on them. It would also make sense to add these species to Table 3-25 (non-listed species in the affected area).	Reclamation developed a species list that is consistent across the entire project area. To do this, Reclamation based the list on BLM sensitive species within a set buffer of the river corridor. This is a comprehensive list and is included in the affected environment discussion in Section 3.13.1 of the SEIS. The comprehensive table in Appendix G has a column noting whether the species is likely to be affected by the alternatives. Only those with yes are discussed in environmental consequences, Section 3.13.2. Section 3.13.1 also notes that the LCR MSCP is concerned about additional species that are not BLM sensitive. Impacts on those species from the LCR MSCP are captured through analysis of BLM sensitive species. This is because impacts on wildlife are based on the impacts on the type of habitat they use, as detailed in the vegetation section. Added clarifying text linking the specific LCR MSCP species of concern to their habitat types.
557	23	CONSBIO - Consultation and Coordination BIO	It appears that no ESA Section 7 interagency consultation occurred, and no biological assessment was developed, with regard to any listed species reliant on the Salton Sea ecosystem and potentially affected by the Proposed Action's impacts on the Salton Sea ecosystem. I suggest that such consultation and assessment, and issuance of a final biological opinion, are required.	Reclamation is consulting with US Fish and Wildlife Service, a cooperating agency on this SEIS, and is preparing a Biological Assessment to support a Biological Opinion. Additionally, an ESA Section 7 interagency consultation is occurring though a distinct National Environmental Policy Act (NEPA) process associated with the IID SEIS system conservation action.
115	6	CONSCR - Cooperation and Coordination CR	The Process is Broken--Consultation is Not Enough The persistence of our Federal trustee to prioritize the protection and development of state water rights illustrates the importance of establishing tribal representation on the Upper Colorado River Commission (Commission). We have a longstanding request to secure representation on the Commission, and this effort has the support of the Colorado River Basin Tribes Partnership.16 The Secretary has the authority, consistent with her trust responsibility, to allow the Tribe to participate on the Commission in an ad hoc capacity, or as the Federal Commissioner's alternate, in order to give voice to tribal interests and help protect the Indian water rights in the Upper Colorado River Basin. This would also show recognition of our Tribe as a sovereign tribal government with vested Indian water rights, and is consistent with meaningful participation of our Tribe, as an equal sovereign to the states, in the discussions and decisions that affect the management and use of water in the Colorado River Basin. Consultation is not enough.	Reclamation is exploring options to address these issues. However, the suggested action is outside the scope of this SEIS. Reclamation is engaging in ongoing consultation with tribal governments and will continue to do so into the future.
116	5	CONSCR - Cooperation and Coordination CR	As with all Colorado River decision-making, it is essential that tribal sovereigns, along with state and federal sovereigns, be active participants in the process. As you are aware, in a letter dated November 15, 2021, twenty basin tribes identified some key guiding principles regarding the long term management of the Colorado River system. Foremost among these principles was that "[t]he federal trust responsibility requires that the United States ensure Basin Tribes are included in the development and implementation of the policies and rules that will govern how the Colorado River will be managed from this point forward."	Reclamation agrees that Basin tribes should be included in the development and implementation of policies and rules that govern how the Colorado River will be managed. In response to Tribal feedback, the Department of the Interior established the first-ever Federal-Tribal-State partnership to promote equitable information-sharing and discussion among the sovereign governments in the Colorado River Basin. All 30 Colorado River Basin Tribal Nations and the seven U.S. basin states have been invited to participate in this new group. The Record of Decision for this SEIS will include requirements for Reclamation to consult with both Basin States and Basin tribes regarding implementation of the Guidelines.
296	3	CONSCR - Cooperation and Coordination CR	We appreciate that Reclamation has identified CRIT as a potential participant for compensated conservation. Revised DSEIS 3-326. As we have stated many times, Tribal Nations with senior rights like CRIT must be part of the solution otherwise it will not be durable. While CRIT will need to consider carefully any proposal for compensated conservation before deciding whether to participate, we look forward to further dialog on this topic.	Thank you for your comment. Reclamation looks forward to continued dialogue and consultation with CRIT.

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297	29	CONSCR - Cooperation and Coordination CR	The SEIS lacked any reference to tribal input on the management of reservoir operations to these resources.	Thank you for your comment. Reclamation is engaging in ongoing consultation with tribal governments, as described in Chapter 4 of the SEIS, and will continue to do so into the future.
297	32	CONSCR - Cooperation and Coordination CR	The need to consult tribes on impacts to Glen Canyon Resources According to the National Park Service, 19 American Indian tribes and bands have an association and cultural affiliation with Glen Canyon - including contemporary descendants of the people who left behind the thousands of archeological sites in the canyon55. The Navajo, Hopi, Ute, Southern Paiute, Zuni and Puebloan tribes all have deep connections to Glen Canyon, and consider it to be part of their ancestral homelands. When the canyon was flooded, hundreds of tribal members were displaced56 - their homes, farms and sacred sites drowned57. As more ancestral lands emerge from the reservoir, there is an opportunity for the federal government to develop cooperative tribal management associated with their historical use of the area. Recreational and other experiential economic opportunities exist for guiding, like the Hualapai tribe does in the Grand Canyon, or the Navajo Nation does in Antelope Canyon. The DSEIS should have consulted tribal leadership on management of Glen Canyon's emerging archeological, ecological, and recreational resources.	Reclamation agrees that Basin tribes should be included in the development and implementation of policies and rules that govern how the Colorado River will be managed. In response to Tribal feedback, the Department of the Interior established the first-ever Federal-Tribal-State partnership to promote equitable information-sharing and discussion among the sovereign governments in the Colorado River Basin. All 30 Colorado River Basin Tribal Nations and the seven U.S. basin states have been invited to participate in this new group. The Record of Decision for this SEIS will include requirements for Reclamation to consult with both Basin States and Basin tribes regarding implementation of the Guidelines.
310	13	CONSCR - Cooperation and Coordination CR	Historically, the original inhabitants of the Colorado River Basin have been left out of water negotiations despite their sovereign status, the U.S. government's trust responsibility to Tribal nations, and the deep interest that Tribal members have in water protection. As far as we know, Native American Nations, Tribes, Communities, Bands, Rancherias, and Pueblos are still excluded from negotiations occurring among the states of the Colorado River Basin. These Native American sovereign governments of the Colorado River Basin need to be included in the negotiations among the Basin states immediately.	Thank you for your comment. Reclamation is engaging in ongoing consultation with tribal governments and will continue to do so into the future. Negotiations occur with individual tribal governments as well as with states and irrigation districts.

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380	7	CONSCR - Cooperation and Coordination CR	Government to Government Consultation Section 2 of the Standards for Tribal Consultation states "Consultation requires that information obtained from Tribes be given meaningful consideration, and agencies should strive for consensus with Tribes or a mutually desired outcome." The Standards present best practices and consultation policies that call on federal agencies to incorporate Tribal treaty and reserved rights into agency decision making with the goal of co-management and co-stewardship of federal land and water. The Draft SEIS states that Reclamation has ongoing consultation relationships with federally recognized Tribes who have unresolved water rights (Tables 4-2 and 4-3; p. 4-4). The EPA is aware the Water and Tribes Initiative4 may also provide a forum for longer term water management and policy discussions. The Colorado River Basin Ten Tribes Partnership Tribal Water Study acknowledges that government-to-government coordination among Tribal, federal, and state governments and cooperation with other Basin water users is the preferred and most effective pathway to address challenges and disparities in the coming years (Study pg. 9-2). Reclamation considers the NEPA scoping and public comment periods to be fundamental parts of the consultation process (Summary of Tribal Consultation Efforts pgs. 4-8/13). Because other water users who currently rely on unused Tribal water may be required to adjust or reduce supplies as Tribes increase or further develop their reserved water rights, it is important that the full scope of unsettled Tribal water rights, as well as identified Tribal water management concerns and recommendations, be disclosed. Recommendations: For the Final SEIS, include a discussion of whether and how meaningful consideration has been given to the observations and concerns of Tribes by addressing them specifically in the Final SEIS. In anticipation of any Post-2026 changes to the Guidelines or operations, the EPA recommends that current and future Tribal water use and development based on the most recent basin water supply and demand studies/forecasts be assessed, and that a technical analysis of the potential impacts from the full development of Tribal water be provided.	Thank you for your comment. Reclamation prepared this SEIS to analyze the potential environmental effects of the proposed action. Section 3.7 of the SEIS analyzes impacts to water deliveries based on entitlements. As described in Section 3.3, a Shortage Allocation Model was used in addition to the CRMMS to analyze the potential impacts of the alternatives on individual water users including tribes within each Lower Division State. Appendix E further explains the Shortage Allocation Model and how impacts to entitlements were analyzed. Reclamation has given meaningful consideration to the observations and concerns raised by tribes, and Reclamation continues to consult with tribes on the impacts to and administration of their water rights. The SEIS does not impose or assume restrictions on tribal use of water entitlements. The analysis in the SEIS does not modify any water entitlement or applicable statutory, settlement, or contract terms.
553	6	CONSCR - Cooperation and Coordination CR	The San Luis Rey Settlement facilitated by the Settlement Act is a good example of local and tribal governments working with the federal government to make water available through infrastructure improvement and conservation measures. Escondido and VID recommend that Reclamation consider integrating into the Final SEIS for Near-term Colorado River Operations and the Development of Post-2026 Operational Guidelines and Strategies for Lake Powell and Lake Mead the implementation of similar relationships involving multi-party cooperation and conservation measures.	Noted.

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557	22	CONSCR - Cooperation and Coordination CR	In part 4.4 "Tribal Consultation and Coordination," the Revised Draft SEIS states, "For purposes of this NEPA process, Reclamation is consulting and coordinating with Tribes who have entitlements to or contracts for Colorado River water and those that may be affected by or have interests in the proposed federal action"89 However, it appears that Reclamation did not consult or coordinate with Tribes in the northern Salton Trough, including but not limited to the Torres Martinez Desert Cahuilla Indian Tribe, concerning the Revised Draft SEIS and the details of the Proposed Action and its reasonably foreseeable effects.90 I suggest that is a significant omission that should be remedied. Tribes in the northern Salton Trough will foreseeably suffer negative effects if Reclamation selects and implements the Proposed Action, or any other action alternative that substantially reduces freshwater inflows to the central Salton Basin. In particular, the Torres Martinez Desert Cahuilla Indians, whose traditional lands and reservation include portions of the Salton Sea and directly adjoin the increasingly exposed lakebed, are especially likely to suffer direct, indirect, cumulative, and disproportionate harm. I suggest it is crucial for Reclamation to consult and coordinate with the Torres Martinez Desert Cahuilla Indian Tribe regarding the Proposed Action, and regarding measures that should be implemented by USBR to avoid, or to minimize to the maximum feasible extent, all harm to Tribal members, lands, and resources that could result if Reclamation proceeds with the Proposed Action.	This SEIS analyzes impacts at the point of delivery. A comprehensive analysis of effects at the Salton Sea is currently in progress through distinct National Environmental Policy Act (NEPA) processes, which include consultation with tribes such as the Torres Martinez Desert Cahuilla tribe. These processes include the U.S. Army Corps of Engineers - Salton Sea Management Program (SSMP) Phase 1: 10-Year Plan (2018-2028) and the IID 2024-2026 Temporary Colorado River System Water Conservation Project. In addition, Reclamation has agreements with Torres Martinez Desert Cahuilla tribe to provide assistance for tribal concerns at the Salton Sea. These agreements are outside the scope of this SEIS.
297	16	COOPOTHER - Cooperating Agencies	With ten national park units directly affected by Colorado River operations, NPS should play a significant role in developing and assessing operational strategies.	Thank you for your comment. NPS is a cooperating agency and has been extensively involved in development of the SEIS.
297	39	COOPOTHER - Cooperating Agencies	With conditions changing so rapidly on the ground in Glen Canyon National Recreation Area, it will be vital for any operational strategies to provide the resources to assist NPS in planning for adapting to new physical realities at the park.	Thank you for your comment. Reclamation will continue to coordinate with the NPS and other federal agencies regarding Glen Canyon operations within the scope of this SEIS and other appropriate matters.
299	4	COOPOTHER - Cooperating Agencies	Incorporate flexibility and collaborative regional planning: In placing focus on the Proposed Action in the revised Draft SEIS, Reclamation should emphasize the need for and benefits of incorporating flexibility and collaborative regional planning. The three-party agreement between the Water Authority, IID, and MWD is based on a collaborative model for sharing supplies in a mutually beneficial way and demonstrates the kind of flexibility that will be encouraged in the future and the ability to achieve it with existing resources.	Comment noted.

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303	2	COOPOTHER - Cooperating Agencies	The Lower Basin States and Reclamation must follow through. While the short-term solutions offered in the Revised DSEIS are beneficial to the system as a whole, and the measures proposed are considerable, there is more work to be done. To be effective, the actions/commitments that will make the proposed operational changes possible must be fully accomplished. Our organizations applaud the recent announcements by Reclamation acknowledging completion of $64 million in additional water conservation contracts within Arizona and $77.6 million in contracts with the Imperial Irrigation District that also unlock $72 million in Salton Sea restoration investments in California. The rest of the Lower Basin conservation commitments must now be finalized and all contracts must be suitably enforceable to further secure the near-term stability of the Basin and achieve the purpose and need of the DSEIS between now and 2026.	Thank you for your comment. Conservation agreements have either been executed or are reasonably foreseeable. As of December 2023, Reclamation has executed contracts for approximately 1.55 million acre-feet of system conservation water, and is actively working on additional system conservation agreements to be signed in 2024 which could add approximately 800,000 acre-feet through 2026. The Lower Division States and their partners may also enter agreements to implement SEIS conservation and need to be given this flexibility. For example, the Lower Division States have targeted approximately 600,000 additional acre-feet of conserved water in 2023 that would count as SEIS conservation as described in the DSEIS. Reclamation has a strong partnership with the seven Basin States, water users, tribes, and Mexico, and we expect that to continue. This partnership has, among other things, resulted in conservation activities that have added approximately 5.1 million acre-feet to Lake Mead between 2007 and 2022. These types of agreements and partnerships have been effective and Reclamation will continue to utilize them to meet water conservation targets for the duration of the interim period.
303	9	COOPOTHER - Cooperating Agencies	Meeting the challenge of a fully utilized and declining water supply will require updated agreements among states, Tribes, basins, and water use sectors to address the water supply math problem in the Basin. But that, by itself, is only part of the solution. Operational adjustments to Colorado River infrastructure should also incorporate, where possible, suitable measures to avoid, minimize, or mitigate the long-term impacts to resources throughout the Basin.	The purpose of Reclamation's proposed action is to mitigate impacts from ongoing trends in the Colorado River System. There are limited resources for which mitigation might be appropriate in the case of the voluntary conservation actions considered in this SEIS. Biological mitigation measures will be identified in the Biological Opinions issued by the USFWS related to this SEIS.
303	10	COOPOTHER - Cooperating Agencies	Successful development of useful Interim Guidelines requires transparency, inclusiveness, and cooperation. Meaningful solutions to the long-term management of the Colorado River system continue to demand inclusion of and good faith efforts by the Colorado River community to problem-solve the challenges created by the Basin's supply/demand imbalance, drought, aridification, and growth. Professions of good faith are not enough; they must be backed up by transparent and inclusive actions to promote true problem-solving negotiations and exhibit commitments to lessen conflict so as not to undermine the stated goal of greater water certainty for the Basin's people and environment.	Throughout both the SEIS and the Post-2026 planning efforts, Reclamation has been and continues to be committed to inclusive processes. In response to Tribal feedback, the Department of the Interior established the first-ever Federal-Tribal-State partnership to promote equitable information-sharing and discussion among the sovereign governments in the Colorado River Basin. All 30 Colorado River Basin Tribal Nations and the seven U.S. basin states have been invited to participate in this new group. The Record of Decision for this SEIS will include requirements for Reclamation to consult with both Basin States and Basin tribes regarding implementation of the Guidelines.
297	26	CR - Cultural Resources	The DSEIS failed to recognize impacts of reservoir operations on these socially and culturally important resources. With the 65 foot rise of Lake Powell in Summer 2023, 30,000 acres48 of lake shore and tributary canyon were once again submerged, which re-drowned exposed archaeological sites, likely causing additional damage beyond what occurred when the reservoir first filled. The DSEIS highlights potential impacts to these sights after emerging from the reservoir, but fails to acknowledge the impact of being re-inundated by the reservoir. Any decision to "prop up" Lake Powell, even at low levels like 3,520', increases the likelihood that other archeological resources are re-inundated, which happened to sites during runoff in 2023.	As discussed in Section 3.11.2 of the DSEIS, negative impacts from the No Action and Proposed Action are more likely to be from wave action, wet/dry cycling, and increased visitation. The SEIS has been revised to include studies showing that inundation of archaeological sites can actually preserve sites in lake environments. Reclamation is currently working with Tribes and other interested parties to develop a programmatic agreement for the SEIS to ensure concerns regarding historic properties important to Tribes and their cultural values are addressed. Effects to historic properties will be mitigated through adherence to stipulations implemented through the PA.

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306	15	CR - Cultural Resources	Sections 3.11 (P. 3-149), 3.17 (P. 3-310), 3.18 (P. 3-318): The text in section 3.11 states that "This reach extends from the GCNRA into GCNP, the Navajo Indian Reservation, and the Hualapai Indian Reservation". Although noted on P. 3-151, this introductory text should also acknowledge that the Havasupai, Hopi, North Kaibab Band of the Paiute, and Zuni Tribes all have strong cultural ties to the landscape, regard that reach as part of their traditional land, and therefore and rightly are invested in management decisions about the landscape. This same text should be applied in Section 3.17, as potential consequences to Tribes with landscape affiliation may involve social but not necessarily direct economic impacts.	The statement "The Havasupai, Hopi, Hualapai, North Kaibab Band of the Paiute, and Zuni Tribes all have strong cultural ties to the landscape and regard that reach as part of their traditional land" has been added to the SEIS in Section 3.11.1 under the heading "Glen Canyon Dam to Lake Mead".
314	7	CR - Cultural Resources	Many of these Tribes and other Native American communities in the Colorado River Basin have spent millenia living in symbiosis with the Colorado River despite droughts, floods, and other extreme environmental conditions. Their wealth of experience passed down through generations should be sought out and prioritized in the development of NEPA alternatives. The use of Indigenous Traditional Ecological Knowledge should be used to inform federal decision making as directed by White House Memorandum dated November 15, 2021, Indigenous Traditional Ecological Knowledge and Federal Decision Making.	Tribal consultation is ongoing to address Tribal impacts and incorporate Traditional Ecological Knowledge as it becomes available.

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557	12	CR - Cultural Resources	The Revised Draft SEIS explains that, for purposes of its analysis, cultural resources "include historic and prehistoric buildings, structures, sites, and objects, including Indian sacred sites and traditional cultural properties."45 There are many known "historic and prehistoric... structures, sites, and objects, including... sacred sites and traditional cultural properties" of the Desert Cahuilla Indians in the Salton Sea region. In addition, many relevant locations have not been surveyed for the presence of such resources but may contain them. The Revised Draft SEIS presents an inadequate analysis of potential adverse impacts on such cultural resources at the Salton Sea, and in adjoining and adjacent areas, that could result from the Proposed Action. The Desert Cahuilla Indians have lived in the northern Salton Trough for many thousands of years, and throughout that time have relied upon a variety of traditional cultural properties and other cultural resources in the central Salton Basin, including but not limited to: large lakes; their tributaries, shorelines, and wetlands; associated wildlife, such as fish and birds; and the area's groundwater and springs. The Desert Cahuilla Indians also created and utilized culturally important sites, structures, and objects (e.g., fish traps, ceramic objects, projectile points, and walk-in wells) for traditional Tribal activities in the Salton Basin related to the foregoing cultural resources. In particular, the traditional territory and the reservation lands of the Torres Martinez Desert Cahuilla Indians directly adjoin the Salton Sea and its increasingly exposed lakebed; and they also include regions of the lake itself, as well as areas that were within the lake but are now part of the exposed lakebed because of the QSA water transfers. Hazardous dust blowing off of the Salton Sea's increasingly exposed lakebed, toxic algae blooms in the lake and associated tributaries and wetlands, noxious fumes emanating from the lake and its marshes as the ecosystem collapses from freshwater deprivation, and the death and disappearance of fish and birds because of the lake's declining health all constitute significant negative impacts on the cultural resources of the Torres Martinez Desert Cahuilla Indians. The resources being harmed "(a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community."46 It is reasonably foreseeable that injurious effects on the traditional cultural properties and cultural resources of the Tribe will worsen if the Proposed Action is implemented. The Revised Draft SEIS should have evaluated these issues, but did not.47 The Revised Draft SEIS admits that some areas relevant to potential impacts of the Proposed Action on cultural resources, including but not limited to archaeological resources, have not previously been surveyed for the presence of such resources. Moreover, the text acknowledges that "the resource potential of the dry lake bed is unknown because no subsurface investigations have been done (US Army Corps of Engineers 2022)."48 Nonetheless, the Revised Draft SEIS asserts the conclusory finding that "No additional impacts on [cultural or archaeological] resources at the Salton Sea would occur under either alternative."49 This claim is unsupported and inappropriate.	As discussed in Section 3.11.2 Issue 2 of the SEIS, flows into the Salton Sea under the Proposed Action would be less than the No Action and would expose the lake bed more quickly; however, long term, the amount of exposure would be the same as the No Action. Under the Proposed Action, lake bed exposure would occur more quickly but not be greater in area than the No Action. This SEIS analyzes impacts at the point of delivery, therefore, impacts to the Salton Sea have been described under cumulative effects. Topics mentioned by the commenter are being analyzed in separate NEPA efforts such as the USACE Salton Sea Management Program Phase I: 10-Year Plan EA and the IID 2024-2026 Temporary Colorado River System Water Conservation Project.

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285	4	CUMU - Cumulative Effects	While the recently-signed 2023 System Conservation Implementation Agreement with IID will have limited impact on inflows to the Salton Sea this calendar year in the context of Hurricane Hilary and existing IID underruns, the reduction of an additional 800,000 acre-feet of inflows to the Imperial Valley in the next three years certainly could. The immediate and cumulative impacts of these additional inflow reductions to the Salton Sea will adversely affect water quality, air quality, biological resources, socioeconomics, and environmental justice in the valley and must be mitigated in a timely fashion. The SSMP 10-Year Plan projects can not be relied upon to mitigate these impacts, neither now nor in the future.	This SEIS analyzes impacts at the point of delivery. Site-specific impacts are being analyzed in USACE's separate EA and in the IID 2024-2026 Temporary Colorado River System Water Conservation Project EA. Mitigation is appropriately addressed through these other NEPA processes.
290	6	CUMU - Cumulative Effects	Relying on protocol and the 10-Year Plan released in 2017 and then updated in 2018 - a plan that was based on a false assumption that the importation of seawater was not feasible plan - and related provisions in official documents that have been initiated, crafted, and inserted by those who promote the destruction of the Salton Sea is wrong approach to very serious problem. The IID is working on their mission for the last 20 years. A leadership is missing - a person with gravitas, necessary knowledge, and power to unite agencies in common interest to save and restore the Salton Sea. The honorable members of the BoR, CNRA and U.S. Army Corps of Engineers (USACE) must use common sense and logic and take initiative in correcting this problem. There is no logical reason for continuing with the "current course of action" and losing another 5 years and revenue of at least $500,000,000 per year in order to save someone's ego and wrongdoing. My calculations are conservative. A more realistic loss of revenue would be about $1,000,000,000 per year just from clean renewable energy in addition to loss of revenue from other activities including tourism. Manipulative and illegal conduct must be taken out of equation when dealing with so important issues such as the Salton Sea, environment, health of nearby population, and economy in general.	Revenue loss and leadership associated with Salton Sea management are not within the scope of this SEIS.
310	32	CUMU - Cumulative Effects	Reclamation needs to model and operate their responsibilities in the Colorado River not only for day-to-day operations but the impact of those operations into the future (on the order of 30 years). Section 3-5 (RDSEIS, pp. 2-10 to 2-11) only considers the cumulative impacts of two other projects, LTEMP and the Salton Sea. What about other current projects, some of which are dismissed? What about the cumulative impact of this project considered in context with all the actions Reclamation has taken on the Colorado River since 1902, including dam building, water management, diversion of water away from the river and out of the Basin, invasion of exotic vegetation, introduction of exotic animal species (e.g., fish), modification of the river's channel, and existing impacts on Native American culture and livelihood? Most of these cumulative impacts have gone unmitigated and date back to well before the passage of NEPA and in fact to the beginning of the twentieth century, and for Native American peoples, to the time of European entry into their homelands.	Projects must be reasonably foreseeable with enough detail known to be analyzed. Past actions are accounted for in affected environment discussions.

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548	6	CUMU - Cumulative Effects	3.5 CUMULATIVE IMPACTS (3-11): Section 3.5.1 refers to the LTEMP SEIS that is currently in the scoping/drafting phase. Having seen multiple comment letters submitted in that process, CREDA questions how the results of an as yet to be completed SEIS can be incorporated into THIS DSEIS as a cumulative impact. Further, as "critical reservoir elevations" are necessary elements in both this DSEIS and any operations associated with the prevention and management of warm-water invasive species such as the smallmouth bass, the effects analysis for both NEPA processes are interrelated and must be identified and disclosed in both processes.	The Draft LTEMP EIS will be released prior to this Final SEIS and both process recognize the actions of the other through the cumulative impacts analysis. This process commits to working within the bounds of LTEMP as amended.
548	11	CUMU - Cumulative Effects	3.15.2 ENVIRONMENTAL CONSEQUENCES/CUMULATIVE EFFECTS (3-260): Please see previous comments regarding status of the LTEMP SEIS in scoping; it is premature to state whether or not certain operational changes would be within the bounds of the current LTEMP, since this process is supplementing that ROD.	The Draft LTEMP SEIS will be released prior to this Final SEIS and both process recognize the actions of the other through the cumulative impacts analysis. This process commits to working within the bounds of LTEMP as amended.
297	5	DATA - Data Sources	The use of the 30-year statistical modeling is historically the standard for water managers, but in the Colorado River Basin it has proven to be outdated and leaves water managers and stakeholders unprepared when a series of dry years reduces the volume of supply to the reservoirs. We believe Reclamation should incorporate a wider set of data, like those used and suggested by the Futures of the Colorado Group10 and Western Water Assessment11, in 24-month and 60-month projections. [https://www.science.org/doi/10.1126/science.abo4452] [https://scholar.colorado.edu/concern/reports/8w32r663z]	Flows from the past 30 years include the driest 23-year period on record. To examine even worse drought conditions, the hydrologic modeling examines Basin flow scenarios with 90 percent and 80 percent of the flows seen over the past 30 years (up to a 20 percent reduction in flows compared with the last 30 years).
297	17	DATA - Data Sources	it is essential that decisions around how to manage Lake Powell, Glen Canyon, Grand Canyon, and Canyonlands incorporate up-to-date information on changing and emerging resources in those park units.	Thank you for your comment. Recreation at the areas listed in the comment is administered by the National Park Service, and is beyond the authority of Reclamation and the scope of this document.

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410	10	DATA - Data Sources	The Revised DSEIS puts off significant decision-making concerning deliveries from Lake Mead, deferring first to the Lower Division States, and then ultimately to Reclamation. The Revised DSEIS explicitly acknowledges that this future decision-making is not modeled in the Proposed Action, but indicates that the percent of traces that fall below Lake Mead elevations of 1,025 and 1,000 feet can be used to estimate the possibility of this occurring. While this modeling (shown in Table 3-16) suggests that the chances of Lake Mead falling below 1,000 feet are indeed remote (0% in 2024 and 2025, and 2% in 2026), the traces for 1,025 feet are far closer to the 10% minimum probable trigger for future decision-making in a April 24-Month Study: by 2026, 8% of traces dipped below this elevation. A comparison of historical modeling with actual elevations at Lake Mead provides further evidence that tripping the 10% minimum probable trigger is far more likely than the estimates in Table 3-16 suggest. Indeed, actual elevations at Lake Mead fell below the projected minimum probable elevations in recent April 24-Month studies on multiple occasions. For example, from April through September 2021 levels at Lake Mead dropped from a high of 1,079.30 feet to 1,067.68 feet; all of these actual elevations were below the projected minimum probable elevations as reflected in the April 2020 24-Month Study. This phenomenon carried forward into subsequent years; actual levels at Lake Mead from April 2022 through March 2023 were lower than the minimum most probable levels for each of those months in the April 2021 24-month study. More to the point for NEPA purposes, this data shows that the 1,025 foot elevation trigger for a minimum most probable projection in a future April 2024 Month Study is reasonably foreseeable. However, the Revised DSEIS explicitly does not model significant adverse impacts (in this case, additional unilateral delivery reductions) that could arise from these reasonably foreseeable events. Reclamation officials have indicated that additional measures to protect Lake Mead elevations will include voluntary conservation measures rather than involuntary reductions. Reclamation should confirm this understanding in the final SEIS.	As noted in Section 2.7, Proposed Action, "Whenever Lake Mead's content is projected to be below an elevation of 1,025 feet, based on the April 24-Month Study minimum probable projection, the Lower Division States, after consultation with the Upper Division States, would have 45 calendar days to provide Reclamation with an implementation plan to protect Lake Mead from reaching an elevation of 1,000 feet. If an implementation plan is not acceptable to Reclamation, then Reclamation may take additional action to protect 1,000 feet." This SEIS does not project or limit what those additional actions may be, but Reclamation would consult with tribes on any additional actions that may affect tribal water rights.
282	5	EDIT - Editorial	Comment 5: Page 3-268, Figure 3-76 This figure is a bit confusing. The Composite rate numbers are correct for no action an proposed action, but under the next two columns, there should only be one set of difference values for the whole table and they are repeated and should not be. Perhaps delete the top 4 lines of each difference and percent difference and just leave the bottom 4 lines.	Table 3-76 has been updated to remove the redundant analysis.

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294	6	EDIT - Editorial	The Revised SEIS should be modified to include language at section 2-8, clarifying that the Secretary's reservation of the right to operate Reclamation facilities to address extraordinary circumstances is limited to Glen Canyon and Hoover Dams. The SEIS states "[f]or all operations, the Secretary reserves the right to operate Reclamation facilities to address extraordinary circumstances, as described in Section 7(D) of the 2007 Interim Guidelines, including 'operations that are prudent or necessary for safety of dams, public health and safety, other emergency situations, or other unanticipated or unforeseen activities arising from actual operating experience.'" (EIS p. 2-8). The sentence should be revised to state, "[f]or all operations at Glen Canyon and Hoover Dams, the Secretary reserves the right to operate Reclamation facilities at or downstream of Glen Canyon Dam to address extraordinary circumstances, as described in Section 7(D) of the 2007 Interim Guidelines, including 'operations that are prudent or necessary for safety of dams, public health and safety, other emergency situations, or other unanticipated or unforeseen activities arising from actual operating experience.'"	The text has been revised to: "[f]or all operations within the scope of the Interim Guidelines, the Secretary reserves the right to operate Reclamation facilities to address extraordinary circumstances…"
306	1	EDIT - Editorial	P. 1-11: "...The NPS is primarily responsible for conservation of natural...resources..." This statement is not entirely correct in that the Arizona Game and Fish Department claims responsibility for fish and wildlife in Arizona's portion of the project area, including Grand Canyon National Park.	This text is describing responsibilities of cooperating agencies rather than providing a comprehensive description of management agencies.
306	2	EDIT - Editorial	P. 2-13: "If such an acceptable plan, as determined by Reclamation, is not developed, Reclamation may independently take action(s) to protect 1,000 feet." Change to "If such an acceptable plan, as determined by Reclamation, is not developed, Reclamation may independently take action(s) to protect a surface elevation of 1,000 feet."	The suggested text has been added.
306	18	EDIT - Editorial	Section 3.16: P. 3-166. Non sequitur or text missing: "The water sources that support hanging gardens originate from natural springs and seeps within the Navajo Sandstone formation and are independent of Lake Powell. Livestock grazing is allowed at GCNRA, with the Bureau of Land Management administering the grazing permits."	The text identified was reviewed for clarity and it was determined that no changes to the EIS are necessary. The point is that there is grazing activity in the area that is independent of this action.
322	4	EDIT - Editorial	In Section 2.4, the Revised Draft SEIS indicates that "The Department may select different parts of any of the alternatives to best meet the Purpose and Need." Revised Draft SEIS at 2-2. That language appears to be holdover language from page 2-2 of the April 2023 Draft SEIS. Given that the Revised Draft SEIS has only one action alternative and a no action alternative, the text is unclear, and that sentence is unnecessary to the rest of the paragraph. The Arizona Agencies recommend that Reclamation delete that sentence to remove any confusion. The analysis in the Revised Draft SEIS of the alternatives is insufficient to include any elements of Alternative 1 and 2 from the April 2023 DSEIS in the FSEIS. The FSEIS should confirm that elements of Alternatives 1 and 2 will not be included in the Proposed Action. We appreciate Reclamation's efforts to conclude the process for revising near-term operations and shift the focus to the Post-2026 operational guidelines. We have also included additional editorial suggestions under Appendix A to this letter.	The referenced text has been removed.
326	9	EDIT - Editorial	[Second page of DSEIS, Mission Satements] The last sentence of the mission statement is incomplete, please update.	This has been corrected.

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326	27	EDIT - Editorial	[section 3.13.1, page 3-183] "For habitat requirements for the species in Table 3-24 and Table 3-25, see NatureServe Explorer (2023), which is incorporated by reference." This is not the right way to incorporate by reference. The DSEIS must at least have a summary of the habitat requirements, even if it's only a table, and then lead the reader to another document for details.	Since NatureServe is a readily available resource, text has been changed to refer the reader to NatureServe to view habitat descriptions.
326	31	EDIT - Editorial	[Section 3.13.1, page 3-185] Change "This species has high tolerances for water temperature, salinity, and dissolved oxygen concentration" to "This species tolerates wide temperature fluctuations, low dissolved oxygen, and high salinity (Service 1993).	Change made to text.
326	37	EDIT - Editorial	[Section 3.13.2, line 23, page 3-188] typo. Change "Section 13.11.1" to "Section 13.13.1."	The typo has been corrected.
326	44	EDIT - Editorial	[Section 3.13.2, Tables 3-26, 3-27] In these tables, it's not clear which values represent the conditions under the no action versus the conditions under the proposed action. Please clarify.	The values in the tables are all relative to the No Action alternative as indicated in the text, table titles, and table footnotes.
326	66	EDIT - Editorial	[Section D.7.3, page D-25] C.7.3.6 System Conservation in Appendix D is mislabeled, assuming the title should be D.7.3.7 System Conservation. Please correct if needed.	This has been corrected.
138	2	EJ - Environmental Justice	In order to keep water flowing to the Lower Basin users Lake Powell has depleted its storage of water and the level of the lake has dropped to the point that it has at times precluded any recreational (economic) activity on its north end. This began December 2, 2021 and continues to this point in time with only limited operational capabilities. During periods of 2021-2023, its south end was compromised to the point that recreational utilization, and its attendant revenue, almost vanished. While we recognize the importance of water deliveries and hydroelectric power generation, it is important to recognize the economic benefits of recreation use of these waters is comparable to the economic benefits of the other uses and vitally important to the communities that rely on these benefits. The negative impacts of lost recreation access disproportionately impact Navajo Nation tribal communities on the southern border of the GCNRA, as well as Page, Arizona.	Thank you for your comment- the SEIS includes baseline data on the importance of water based on recreation for the regional economy (see for example, Table 3-92, with the total economic contributions from recreation occurring in the GCNRA, LMNRA, and GCNP). In addition, the economic analysis acknowledges the potential for economic impacts to the recreation sector and regional economy as a result of reservoir level changes. Insufficient information is available on specific changes to recreation visitation levels to provide input data for quantitative recreation contribution analysis by alternative. In the Draft SEIS, in Section 3.17.2, under Issue 1, Socioeconomics, the EJ analysis notes the potential for changes to recreation-based economic contributions and how the location of impacts would vary by shortage level. The FEIS has been revised to note that reduced revenue associated with reduced recreation would result in potential for impacts to tribes/EJ communities, however the magnitude of impacts would depend on the degree to which tribes/EJ communities rely on revenue generated from recreation. The purpose of the SEIS is to supplement the 2007 Interim Guidelines to modify guidelines for operation of the Glen Canyon and Hoover Dams to address historic drought, historically low reservoirs, and low-runoff conditions in the Basin. The need for the modified operating guidelines is based on the potential that continued low-runoff conditions in the Basin could lead Lake Powell and Lake Mead to decline to critically low elevations, impacting operations through the remainder of the interim period (prior to January 1, 2027).

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285	12	EJ - Environmental Justice	Salton Sea continues to be an urgent environmental and public health crisis for residents across the eastern Coachella Valley (ECV). As currently written, the Draft SEIS fails to adequately address impacts to the Salton Sea and the associated impacts on communities near the Salton Sea. The Salton Sea region, including the ECV, consists of environmental justice communities that are already being subjected to disproportionately high and adverse environmental, health, social, and economic consequences such as asthma, bronchitis, pneumonia, nosebleeds, allergies and other chronic respiratory health impacts as a result of rapidly depleting water levels in the Salton Sea. Additional conservation measures for the Colorado River will have both direct and indirect impacts on the Salton Sea which will have associated impacts on communities near the sea. As per Executive Order 12898, each Federal Agency must "make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low income populations." 5 Furthermore, as per Executive Order 14096 federal agencies are required to "identify, analyze, and address disproportionate and adverse human health and environmental effects (including risks) and hazards of Federal activities, including those related to climate change and cumulative impacts of environmental and other burdens on communities with environmental justice concerns."	Actions considered in this SEIS are not the main drivers of change in Salton Sea exposed lakebed. There are many sources of dust emissions in the Imperial Valley, and Reclamation acknowledges that the Salton Sea is one of them. This SEIS is analyzing a short timeframe of the remainder of the interim period, through 2026. Further, the total amount of lakebed exposure does not vary between the No Action Alternative and the Proposed Action in this SEIS. The SEIS Proposed Action and the No Action Alternative would result in the same level of lakebed exposure; the alternatives only vary in the rate of exposure. Section 3.9.2 acknowledges that dust is a concern for the Salton Sea area and that additional dust resulting from decreased water levels would affect local air quality and public health. This section has been revised to note the connection between fugitive dust and respiratory health. Exposed lakebed at Salton Sea contributes a small percentage of dust in the area and there are several sources of dust in the area. Ongoing studies are assessing whether there is any additional hazard posed by Salton Sea lakebed dust compared with other dust sources in the area. For instance, the Natural Resources Conservation Service is currently surveying soil content for other drying lakeshores, such as the Salton Sea, to formulate a dust risk index and to provide insight into potential airborne toxins and effects on human health. Topics mentioned by the commenter are being analyzed in separate NEPA efforts such as the USACE Salton Sea Management Program Phase I: 10-Year Plan EA and the IID 2024-2026 Temporary Colorado River System Water Conservation Project. For instance, the IID 2024-2026 Temporary Colorado River System Water Conservation Project EA will have resource analysis section on Air Quality, Environmental Justice, and Human Health.
285	13	EJ - Environmental Justice	By neglecting to adequately account for impacts to the Salton Sea associated by the Proposed Action, the Draft SEIS subsequently fails to adequately and substantially account for the direct, indirect, cumulative, and disproportionate negative impacts environmental justice communities will face as a result of the Proposed Action.	The SEIS Proposed Action may accelerate some impacts at the Salton Sea, but is not anticipated to change the magnitude of impacts. This SEIS analyzes impacts at the point of delivery. Site-specific impacts are being analyzed in the US Army Corps of Engineers' Salton Sea Management Program Phase 1: 10-Year Plan Environmental Assessment and IID 2024-2026 Temporary Colorado River System Water Conservation Project EA. In addition,
289	1	EJ - Environmental Justice	Comite reiterates the concerns shared it its June 12, 2023 letter regarding the Draft Supplemental Environmental Impact Statement. In particular, the deficiencies in mitigation of impacts to disadvantaged communities in the Imperial Valley.	Thank you for your comment. Reclamation is taking the letter into consideration.
289	4	EJ - Environmental Justice	The Bureau should not defer a full analysis of Salton Sea impacts to its post-2026 environmental impact statement. The tribes and disadvantaged communities living in proximity to the Salton Sea deserve a complete and transparent assessment of how their region may fare under the full potential range of hydrologic conditions.	Thank you for your comment. This SEIS is analyzing a short timeframe of the remainder of the interim period, through 2026. Actions considered in this SEIS are not the main drivers of change in Salton Sea exposed lakebed, because it would not change the overall exposure of the lakebed over the long term. There are many sources of dust emissions in the Imperial Valley, and Reclamation acknowledges that the Salton Sea is one of them. Please refer to separate NEPA efforts such as the USACE Salton Sea Management Program Phase I: 10-Year Plan EA and the IID 2024-2026 Temporary Colorado River System Water Conservation Project EA for more information.

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299	1	EJ - Environmental Justice	Recognition of impacts to the Salton Sea: Unlike the original draft SEIS, the revised draft considers the potential for impacts to the sea from increased system conservation, noting that the Proposed Action could expedite, but not result in additional, exposure of lakebed. However, the revised draft does not adequately address the environmental justice impacts to the communities around the sea or the Torres Martinez Desert Cahuilla tribe whose land is located next to the sea. It is critical that Reclamation recognizes those impacts and that adequate funding be awarded to address the need for environmental mitigation above what is already being provided under the QSA.	Actions considered in this SEIS are not the main drivers of change in Salton Sea exposed lakebed. There are many sources of dust emissions in the Imperial Valley, and Reclamation acknowledges that the Salton Sea is one of them. This SEIS is analyzing a short timeframe of the remainder of the interim period, through 2026. Further, the total amount of lakebed exposure does not vary between the No Action Alternative and the Proposed Action in this SEIS. The SEIS Proposed Action and the No Action Alternative would result in the same level of lakebed exposure; the alternatives only vary in the rate of exposure. Section 3.9.2 acknowledges that dust is a concern for the Salton Sea area and that additional dust resulting from decreased water levels would affect local air quality and public health. This section has been revised to note the connection between fugitive dust and respiratory health. Exposed lakebed at Salton Sea contributes a small percentage of dust in the area and there are several sources of dust in the area. Ongoing studies are assessing whether there is any additional hazard posed by Salton Sea lakebed dust compared with other dust sources in the area. For instance, the Natural Resources Conservation Service is currently surveying soil content for other drying lakeshores, such as the Salton Sea, to formulate a dust risk index and to provide insight into potential airborne toxins and effects on human health. Topics mentioned by the commenter are being analyzed in separate NEPA efforts such as the USACE Salton Sea Management Program Phase I: 10-Year Plan EA and the IID 2024-2026 Temporary Colorado River System Water Conservation Project EA. For instance, the IID 2024-2026 Temporary Colorado River System Water Conservation Project EA will have resource analysis section on Air Quality, Environmental Justice, and Human Health. Reclamation has agreements with Torres Martinez Desert Cahuilla tribe to provide assistance for tribal concerns at the Salton Sea. These agreements are outside the scope of this SEIS. Reclamation will be consulting with Torres Martinez Desert Cahuilla tribe regarding the agreement with IID.
303	7	EJ - Environmental Justice	It is a basin-wide ecosystem that we all depend on to provide quality drinking water, - food and fiber, growth and stability in energy and the economy, cultural and spiritual connection, and irreplaceable habitat for species.	Thank you for your comment.
380	1	EJ - Environmental Justice	incorporate new environmental justice policy guidelines into the analysis; [see comment letter below for narrative]	The SEIS is consistent with Executive Order (EO) 14096 Revitalizing Our Nation's Commitment to Environmental Justice for All (2023). Further coordination and involvement with communities with environmental justice concerns is being implemented in the development of the post-2026 EIS.

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380	5	EJ - Environmental Justice	Tribal Sovereignty The Draft SEIS considers federally recognized Tribes to be environmental justice populations (p. 3-313). Executive Order 14096 clarifies that "[c]ommunities with environmental justice concerns exist in all areas of the country, including...within the boundaries of Tribal Nations." We note that not all Tribes are communities with environmental justice concerns, and some prefer not to be identified as such. Recommendations for the Final SEIS and Post-2026 Operations: Consider separating Tribal issues and concerns from the broader discussion of environmental justice unless a specific Tribe has requested that their concerns be addressed in the environmental justice section. EPA recommends that Reclamation use its Tribal consultation processes to identify communities with environmental justice concerns for additional environmental justice considerations, analysis, or outreach.	We recognize that not all tribes may want to be identified as environmental justice communities. Reclamation is engaging in tribal consultation and is discussing environmental justice impacts as part of those consultations. No tribes have requested to not be considered for environmental justice impacts. Reclamation will continue tribal consultation on this topic for the post-2026 effort.
484	23	EJ - Environmental Justice	The Environmental Justice section seems to be lacking in that it does not address impacts to CRSP customers outside of the Lower Basin. A significantly changed circumstance since the 2007 Guidelines were completed is the allocation of CRSP resources to 52 Tribes. Impacts from the Proposed Action should be assessed not only for the tribes listed in 3.17.1 from a water delivery standpoint, but also for all the tribes that are now CRSP firm electric service customers from a hydropower impact standpoint. In addition to those 52 tribes, numerous rural electric cooperatives receive CRSP hydropower. Some CRSP customers receive a "bill credit" intended to represent the federal resource benefit. When there is a change in the CRSP resource provided, those entities may receive a smaller (or larger) credit, meaning the federal benefit anticipated since 2004 may be different. Each community is able to decide how best to use the bill crediting benefit in their community. The rate impact to benefit crediting customers should be included in the analysis presented in the DSEIS. The Environmental Justice discussion section related to air quality also seems to be lacking, as does the Air Quality Section. Where are the modeling results related to fugitive dust and other metals and other contaminants that are contained within the dust? The SEIS analysis would benefit from inclusion of this data.	Appendix K of the Final LTEMP EIS analyzes environmental justice impacts and impacts on Tribal customers. Chapter 3 of the LTEMP EIS provides analysis of hydropower and marketing. Overall air quality is improved under the Proposed Action from higher levels at Lake Powell and Lake Mead. Actions considered in this SEIS are not the main drivers of change in Salton Sea exposed lakebed. There are many sources of dust emissions in the Imperial Valley, and Reclamation acknowledges that the Salton Sea is one of them. This SEIS is analyzing a short timeframe of the remainder of the interim period, through 2026. Further, the total amount of lakebed exposure does not vary between the No Action Alternative and the Proposed Action in this SEIS. The SEIS Proposed Action and the No Action Alternative would result in the same level of lakebed exposure; the alternatives only vary in the rate of exposure. Section 3.9.2 acknowledges that dust is a concern for the Salton Sea area and that additional dust resulting from decreased water levels would affect local air quality and public health. This section has been revised to note the connection between fugitive dust and respiratory health. Exposed lakebed at Salton Sea contributes a small percentage of dust in the area and there are several sources of dust in the area. Ongoing studies are assessing whether there is any additional hazard posed by Salton Sea lakebed dust compared with other dust sources in the area. For instance, the Natural Resources Conservation Service is currently surveying soil content for other drying lakeshores, such as the Salton Sea, to formulate a dust risk index and to provide insight into potential airborne toxins and effects on human health. Topics mentioned by the commenter are being analyzed in separate NEPA efforts such as the USACE Salton Sea Management Program Phase I: 10-Year Plan EA and the IID 2024-2026 Temporary Colorado River System Water Conservation Project. For instance, the IID 2024-2026 Temporary Colorado River System Water Conservation Project EA will have resource analysis section on Air Quality, Environmental Justice, and Human Health.

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548	10	EJ - Environmental Justice	3.17 ENVIRONMENTAL JUSTICE (3-316): Another example of a significantly changed circumstance since the 2007 Guidelines were completed is the allocation of CRSP resources to 52 Tribes. Impacts from the Proposed Action should be assessed to not only the tribes listed in 3.17.1 from a water delivery standpoint, but to all the tribes that are now CRSP firm electric service customers from a hydropower impact standpoint. These tribes all have the potential "to be affected by project management".	This SEIS concerns annual release volumes from Glen Canyon Dam and does not propose changes to operations for the CRSP reservoir system outside of Lake Powell. Reclamation recognizes that these components are interrelated. The Proposed Action would continue to outperform the No Action Alternative under the driest conditions, particularly in 2026 when the No Action Alternative has the potential for dropping below minimum power pool and the Proposed Action would greatly outperform the No Action Alternative. This will provide more certainty and reliability in providing hydropower deliveries to all CRSP customers including tribes.
128	1	HHS - Human Health and Safety	As I'm sure you unfortunately know, Utah currently ranks 14th place in the United States for suicide. Dishearteningly, our new position is not the consequence of improved outreach and lower numbers, but instead Utah being surpassed by other states. I believe that this disturbing statistic can be eased by protecting our favorite recreational spots and ensuring their longevity. The current state of Lake Powell adequately reflects the mental state of Utahns; despite the water level seeing a hopeful increase, our lake is still in jeopardy. This mirrors the mental health crisis in which despite being lower on the national suicide rankings, our actual suicide rates have increased.	Comment noted.
283	3	HHS - Human Health and Safety	Again, 5,000 cfs low flows should not be considered a safe whitewater threshold, and this SEIS must be adjusted accordingly. Furthermore, this public safety issue was exacerbated by NO NOTICE of the change in flows - people already on the river in Grand Canyon were completely unaware of (and unprepared for) what was happening. We find this completely unacceptable. The Bureau of Reclamation must commit to providing a minimum of 2 weeks advance notice of any reduction in flow levels to the NPS and to the river running public.	The safe whitewater boating threshold considered in the document is 8,000 cfs. Mention of a 5,000-cfs threshold has been corrected. The safe whitewater boating threshold used in the SEIS is based on best available information, further described in analyses for LTEMP and Colorado River Management Plan (see 4.10.2.4 of the LTEMP FEIS). For that reason, these numbers have been used in this SEIS analysis.
297	40	HHS - Human Health and Safety	GCNRA's management plan has not been updated since 1979 61. GCNRA develops its facilities planning based on projections and guidance from Reclamation62 The recreation landscape at the park is changing at speeds that are almost impossible for the park to keep up with. Last year, there was a two month period where nearly every boat ramp at the reservoir was non-operational, with boat ramps being extended and marinas being moved as quickly as possible. Hite and Dangling rope marinas have closed indefinitely. GCNRA has stated recreational use on the emerged Colorado River in Cataract Canyon/North Glen Canyon has increased dramatically, as has land based recreation around the park63. Yet, the takeout ramp for Cataract Canyon rafting trips near Hite, UT has repeatedly degraded in recent years, creating a safety hazard as well as deterring recreational visitation to the area. Recent communications from GCNRA have indicated possible plans for this access point, but with no timeline and a small budget, which could mean this serious safety issue could persist for years. Public safety in a National Park cannot be left unattended or ignored.	The NPS manages recreation in GCNRA; such management is outside the scope of this SEIS.

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306	10	HHS - Human Health and Safety	P. 3-85 et subsequ., 3-220 et subseq., and 3-330 et subseq. (e.g., P. 3-297): The sections of text referring to water quality (3.8), recreation (3.13), and socioeconomics (3.16) do not include any discussion of bacteriology in relation to warming water temperatures and lower flows. Water-borne disease is a significant challenge for river and reservoir recreation throughout the study reaches, in some cases causing entire river trips to be evacuated or the closure recreational beaches. E. coli and other microbial populations erupt in warm waters, as do various fish parasites (e.g., Lernaea) and diseases. Despite extraordinary levels of recreational visitation, the document makes no mention of the potential bacteriological health risks to the visiting public related to lower, warmer flows. The economic consequences of such impacts may, for some recreational visitors and river running companies be enormous, and should be analyzed in this document	Thank you for your comment. Public health concerns regarding harmful algal blooms, brain-eating amoeba and other waterborne pathogens are discussed in the recreation and water quality affected environment sections. Data to model the increased risk of occurrence of these waterborne pathogens is not available. No change has been made to the SEIS.
308	10	HHS - Human Health and Safety	3. Health and Safety Implications for Endangered Municipalities is Possible, But Has Not Been Analyzed in the SEIS. None of the alternatives presented consider the pronounced, negative health and safety implications of all fourth priority water usage being eliminated. Instead, the issue is relegated to a potential action plan to be developed in a 45- day period from the Basin States, or unilateral action from BOR. Revised Draft SEIS, Section 2.7. Cities such as Bullhead City and Lake Havasu City are fourth priority water users with no alternative source of water available to serve their citizens. These are cities with thousands of residents, hospitals, schools, and businesses. The Revised Draft SEIS does not address what happens if they do not have enough water to provide drinking water to all their constituents. The health and safety impacts of multiple cities having insufficient municipal water supplies will be catastrophic. The Revised Draft SEIS fails to address the issue. Instead, the Revised Draft SEIS treats Mohave County municipal water users the same as other fourth Priority users who do not face the same health and safety impacts from curtailment. The closest the Revised Draft SEIS gets thinking about this issue is: "The economic impacts from domestic and industrial water shortages are unknown due to the variety of approaches the municipalities and other entitlement holders utilize in shortage scenarios, including supply-side actions (such as groundwater recharge, water purchase agreements, and alternative water supplies) and demand-side strategies (such as water conservation measures)." Revised SEIS at p. 3- 306. As stated above, these communities rely solely on fourth priority entitlements without any other sources of water available. Thus, " supply- side" actions are not available to these communities. The only source of water available is from municipal production wells which BOR has unilaterally categorized as pumping Colorado River water. Demand-side strategies are also nonexistent for these communities whose only source of water has dried up under each alternative. The Revised Draft SEIS fails entirely to evaluate the health and safety impacts of entire communities without water.	In the original Draft SEIS, since withdrawn, Reclamation acknowledged that in contemplating volumes of shortage that would eliminate water supply under multiple Colorado River water delivery contract priority groups, widespread impacts on social and economic conditions may be possible and not all impacts may be mitigated. Under such a scenario, Reclamation described unquantifiable direct costs associated with mitigation such as water trucking; other unquantifiable indirect social costs could occur as a result of a reduction in ecosystem services that could persist for decades. Reclamation joins stakeholders in strongly desiring to avoid those kinds of impacts, which were a consideration under the original Action Alternatives 1 and 2; the impacts analyzed in this document are consistent with the No Action and Proposed Action. For the time period and shortage levels examined in the revised Draft SEIS and Final SEIS, impacts from involuntary shortages would be limited because the shortage tiers from Action Alternatives 1 and 2 would not be implemented.

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308	13	HHS - Human Health and Safety	Given the concerns listed above, the SEIS should include a full analysis of the environmental impacts on the health and safety of the entitlement holders for whom the Colorado River is the sole source of water available to them. As the Supreme Court has recognized, "[i]mplicit in NEPA' s demand that an agency prepare a detailed statement on ` any adverse environmental effects which cannot be avoided should the proposal be implemented,' 42 U. S. C. SS 4332(C)(ii), is an understanding that the EIS will discuss the extent to which adverse effects can be avoided." Robertson, 490 U.S. at 352. Thus, the Final SEIS must contain a detailed discussion of the adverse effects of the losing the only source of water for communities that rely on fourth priority water entitlements and if those adverse effects can be avoided. If not, there must be a discussion of the mitigation that can reduce or eliminate those adverse effects as set out below.	Thank you for your comment. Please see the response to comment 259. The DSEIS further notes that intensive efforts are underway to facilitate water conservation actions in the Basin under a number of programs, including the recent congressional prioritization of funding through the Inflation Reduction Act of 4 billion dollars for drought mitigation in western states, with priority given to the Colorado River Basin and other basins experiencing comparable levels of long-term drought (Public Law 117-169 at Section 50233, August 16, 2022). The ongoing implementation of these efforts will help determine the degree to which revised operations will be implemented.
308	14	HHS - Human Health and Safety	4. The Final SEIS Must Consider Appropriate Mitigation Measures, Including Allocating Water for Municipal Health And Safety Uses. An EIS must contain a detailed discussion of possible mitigation measures. Robertson, 490 U, S. at 351. This discussion of mitigation " flows both from the language of the Act and, more expressly, from CEQ' s implementing regulations." Id. see also 40 C. F. R. 1502. 14(e). Currently, the Revised Draft EIS fails to discuss any mitigation. This complete " omission of a reasonably complete discussion of possible mitigation measures ... undermine[s] the action- forcing' function of NEPA. Without such a discussion, neither the agency nor other interested groups and individuals can properly evaluate the severity of the adverse effects." Id. at 352. CEQ regulations recognize" the importance of such a discussion in guaranteeing that the agency has taken a ` hard look' at the environmental consequences of proposed federal action" by requiring " that the agency discuss possible mitigation measures in defining the scope of the EIS, in discussing alternatives to the proposed action, and consequences of that action, and in explaining its ultimate decision." Id. (internal citations omitted). In this case, where alternative water supplies are not available, there is no way to mitigate the risk to public health and safety, other than to allow some limited exceptions to shortage sharing, so long as the water is physically available. That would include allowing fourth priority mainstream entitlement holders to continue to pump from wells in times of shortage. This exception must be made part of any alternative that is chosen. Failure to include such a commonsense and legally required mitigation measure would constitute an arbitrary and capricious action by BOR, subjecting the federal action to legitimate legal challenges.	Thank you for your comment. Please see the responses to comments 259 and 261.

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539	7	HHS - Human Health and Safety	Public Health and Safety Under both actions, Reclamation reserves the right to operate facilities to address extraordinary circumstances, including operations that are prudent or necessary for public health and human safety. As with other actions that may be taken under the emergency clause of the Proposed Action, such operational decisions made in the interest of "public health and human safety" should consider the Law of the River and include a full analysis of a user's available water resources and the impacts to other water users that would result.	Noted.
4	1	HYDROLOGY - HYDROLOGY	First, I am curious why the 80% ESP analysis presented today in the Revised Oct Draft SEIS uses the 1999-2002 period and the analysis used in the April Draft SEIS was from 2011-2014. How was that determined and why not use the same 4-year period.	Email response sent on 12/13/23. Email response included below: The analysis for the Draft SEIS uses the 80%, 90%, and 100% ESP forecasts (90 traces total) for each alternative, including Alts 1 and 2. During the webinar, we showed the 1999-2002 trace from 80% ESP instead of another trace since this trace showed an example of a 6.0 maf release from Lake Powell. The results for 2011-2014 trace from 80% ESP is available with all other traces in our modeling package (details below). Please note that we found a minor issue with modeled Lake Powell releases in a few traces, but overall results from the draft SEIS were not affected. For example, in the No Action alternative, the fix changed 2026 Lake Powell releases in 4 traces. It didn't result in changes to the percent of traces dropping below critical elevations. Modeling/data package: http://bor.colorado.edu/public_web/DataTransfer/CRMMS-SEIS/CRMMS-Revised-DSEIS.zip
4	2	HYDROLOGY - HYDROLOGY	Second, I am wondering if you ran the new trace analysis on the 80% ESP of 2011-2014 hydrology was run with the no action, LB states proposal, and the two original alternatives (Alternative 1 and 2). If so, I am curious what the end-of-month pool elevation graphs look like given the June 2023 hydrology. My sense is that you probably ran this to support your decision not to move forward with the original Alternatives, but am incredibly interested to see it if you can share.	Email response sent on 12/13/23. Email response included below: The analysis for the Draft SEIS uses the 80%, 90%, and 100% ESP forecasts (90 traces total) for each alternative, including Alts 1 and 2. During the webinar, we showed the 1999-2002 trace from 80% ESP instead of another trace since this trace showed an example of a 6.0 maf release from Lake Powell. The results for 2011-2014 trace from 80% ESP is available with all other traces in our modeling package (details below). Please note that we found a minor issue with modeled Lake Powell releases in a few traces, but overall results from the draft SEIS were not affected. For example, in the No Action alternative, the fix changed 2026 Lake Powell releases in 4 traces. It didn't result in changes to the percent of traces dropping below critical elevations. Modeling/data package: http://bor.colorado.edu/public_web/DataTransfer/CRMMS-SEIS/CRMMS-Revised-DSEIS.zip

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115	8	HYDROLOGY - HYDROLOGY	In the event the new modified Colorado River system operations include a modified operation of the Flaming Gorge Reservoir that could potentially alter the present flow release regime of the Reservoir, one would expect that the flow regime of the Green River between Flaming Gorge Reservoir and Lake Powell would be expected to change. As a result, there could be a possibility of potential negative impact on the flow requirement for endangered species of the 3 river reaches, with different flow requirements to protect the fish habitat in the 3 reaches of the Green River. Hence, the SEIS should take into consideration whether the modified flow is in tandem to protect the instream flow requirements necessary for healthy fish habitat and endangered species in the 3 river reaches.	This comment is outside the scope of the SEIS. Reclamation is not changing or analyzing Flaming Gorge operations. Any Flaming Gorge operations will occur within the ROD, including any operations that might be made as part of the DROA process.
283	5	HYDROLOGY - HYDROLOGY	First, hydrology in the Colorado River Basin has improved compared with the hydrology at the time the SEIS analysis began in December 2022. Analysis in the original draft SEIS was based on hydrology from September 2022. Using the September 2022 hydrology, the percent of traces reaching critical elevations at Lake Powell (i.e., below 3,490 feet) through 2026 was 57%, and the percent of traces reaching critical elevations at Lake Mead (i.e., below 1,000 feet) was 52% without additional action. With improved hydrology from June 2023, the percent of traces declining below critical elevations is 8% at Lake Powell and 4% at Lake Mead through 2026.	Comment noted.
283	8	HYDROLOGY - HYDROLOGY	Additionally, as longstanding river stakeholder charged with protecting the Colorado River experience over the long term, and on behalf of our diverse constituency of river guides, outfitters, commercial passengers, private boaters, and other Grand Canyon aficionados, GCRG is adamant that BOR must reconsider the lowest flows that can be safely navigated, given the inherent risks of river running, in different types of craft, especially large motor boats which enable under-served segments of the public to experience Grand Canyon.	The safe whitewater boating threshold used in the SEIS is based on best available information, further described in analyses for LTEMP and Colorado River Management Plan (see Section 4.10.2.4 of the LTEMP FEIS). For that reason, these numbers have been used in this SEIS analysis.
288	6	HYDROLOGY - HYDROLOGY	To ensure Glen Canyon Dam continues to operate under its intended design for purposes of maintaining downstream water releases and protecting infrastructure from the potential consequences of operating at or below critical elevations, Reclamation may need to modify current operations and reduce Glen Canyon Dam downstream releases, impacting downstream resources and reservoir elevations at Lake Mead. Consequently, to protect Hoover Dam operations, system integrity, and public health and safety, Reclamation also may need to modify current operations and reduce Hoover Dam downstream releases	The Proposed Action includes actions to potentially modify releases at Glen Canyon down to 6 maf, and additional system conservation in the lower basin will help protect critical elevations at Lake Mead.
288	13	HYDROLOGY - HYDROLOGY	Reclamation failed to analyze a reasonable range of modifications to the operational tiers for Lakes Powell and Mead and corresponding annual release volumes from Glen Canyon Dam. [see p.12-13 in attachment for analysis]	The range of alternatives analyzed in this SEIS is reasonable. Alternatives that modified operational tiers were considered in the Original Draft SEIS. But alternatives with such modifications were ultimately dismissed from detailed analysis because their performance was similar to or worse than the Lower Division proposal as explained in the Dear Reader Letter to the Revised Draft SEIS and Section 2.8.

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288	25	HYDROLOGY - HYDROLOGY	Resources in Grand Canyon may be negatively impacted by the mid-year reduction of release volumes to protect 3,500 feet at Lake Powell. Despite this example of how the mid-year flow reductions combined with the 3,500 feet elevation protection at Lake Powell may operate to impact resources downstream of Glen Canyon Dam, it is incredibly unclear in the Revised Draft SEIS exactly how the LTEMP minimum flows or reservoir elevations will be prioritized under the revised guidelines. See Section I.D.3, below. Reclamation needs to develop guidance for how these competing goals should play out under the revised guidelines. [see p. 21-25 in attachment for full analysis]	As described in Section 2.7.2, hourly and daily releases would follow LTEMP parameters, so long as sufficient water is available from the annual release. If sufficient water is not available from the annual release to meet hourly and daily LTEMP release parameters, hourly and daily releases would follow the base operation daily and nightly minimum flows (8,000 cfs and 5,000 cfs, respectively), for as long as possible. If sufficient water is not available from the annual release to support the base operation nightly minimum flow of 5,000 cfs, hourly and daily releases would be consistent with the run of the river to match Lake Powell inflows consistent with protecting an elevation of 3,500 feet at Lake Powell.
288	32	HYDROLOGY - HYDROLOGY	Low reservoir elevations at Lake Powell will reduce the opportunities for high flow experiments, which is the only mechanism for distributing sediment, building beaches, and protecting cultural resources in Marble and Grand Canyons. [see p.28-29 in attachment for analysis]	The LTEMP SEIS is addressing changes to the high flow experiment protocol that would align with the goals established in the 2016 LTEMP FEIS. These changes take into consideration the recent drought conditions that Lake Powell is experiencing.
288	34	HYDROLOGY - HYDROLOGY	Reclamation needs to acknowledge the significant groundwater contributions into the Colorado River from Glen Canyon Dam to the full pool at Lake Mead. Reclamation fails to recognize groundwater contributions to Colorado River flows in Marble and Grand Canyons. The Revised Draft SEIS at 3-18 describes flows in the 265-mile river reach between Glen Canyon Dam and full pool at Lake Mead as receiving water primarily from dam releases and additional contributions from the Paria and Little Colorado Rivers representing "less than 3 percent." This assessment, however, disregards the significant contribution groundwater makes to the Colorado River in this reach.	CRMMS assumes gains between Glen Canyon and Hoover and includes contributions and losses from GW and other sources. CRMMS relies on the historical calculated Lower Basin gains and losses for intervening flows between Glen Canyon Dam and Hoover Dam. The calculated gain/loss includes any historical groundwater contributions in this reach, in addition to inflows from the Paria and Little Colorado Rivers. Additional GW effects may be analyzed in the Post 26 EIS.
295	10	HYDROLOGY - HYDROLOGY	Why is 1,000 feet the panic level instead of a much higher Lake Mead level. As a former member of the MWD board, Mark Gold remembers that Met was extremely anxious when water levels dipped below 1,080 feet because Tier 1 reductions were right around the corner. With the current recommendations, it appears as if USBR is ok with Lake Mead levels at 1,000 to 1,025 feet despite the Tier 1, 2 and 3 reductions. And panic only hits below 1025 feet to require actions to develop and implement plans to prevent water levels from ever reaching 1,000 feet. This high-risk approach is only going to make reaching a safe, sustainable Lake Mead level that much harder for post-2026 operations.	There are impacts and operational actions at various water elevations, not just 1,000 feet. Decision-making is driven by preserving the operation of the entire system rather than by the impacts to individuals. The lower basin proposal was written to specifically protect 1,000 feet and reflects the comfort level of the states.
295	11	HYDROLOGY - HYDROLOGY	USBR must take into account evaporation, leakage and other losses throughout the system to more accurately assess potential impacts and to more equitably and sustainably allocate Colorado River resources. For the Lower Colorado Basin states, the estimated loss to evaporation was approximately 0.8MAF in 2021, a substantial volume that needs to be part of the SEIS alternatives assessments.	Reclamation includes evaporation and other losses in its modeling.
295	14	HYDROLOGY - HYDROLOGY	The SEIS should include an assessment of the volumetric benefits of USBR programmatic improvements including strong application of their authority to regulate unreasonable use of supplies.	Any evaluation of provisions related to Part 417 beneficial use is an independent process to ongoing NEPA activities in the lower Colorado River basin.

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295	16	HYDROLOGY - HYDROLOGY	Reclamation could evaluate a measure limiting deliveries to contractors to allow for no more than median levels of unrecovered system losses. That is, if median system losses for such contractors are currently 10%, but a particular contractor's unrecovered system losses are 20%, Reclamation would reduce deliveries to that contractor by 10%. Such a measure could further encourage best practices and reduce system waste; when paired with federal water efficiency incentives, it could reduce system demands without affecting beneficial uses.	This comment is outside the scope of the SEIS as it does not address the purpose and need to address low reservoir conditions across the Basin in the remainder of the interim period, through 2026.
297	35	HYDROLOGY - HYDROLOGY	It's believed a similar waterfall may soon develop near Hite at the end of Narrow Canyon60. The emergence of such a waterfall would create a significant safety hazard and impact the recreation opportunities for private boaters and outfitters who utilize that section of river. If a reservoir-caused waterfall forms near the Hite area, Reclamation must assess the feasibility of dredging or directing the river back in its original channel. Any near or long term operation plans must include development of a comprehensive sediment plan in Glen Canyon. This plan should address issues related to waterway access (river or reservoir), resource impacts, and resource remediation above areas where the reservoir will likely not be anymore. Understanding the sediment dynamics will allow the National Park Service, the Bureau of Reclamation and the State of Utah to actively manage infrastructure and public safety programs within Glen Canyon National Recreation Area. The recently completed USGS sediment survey of Lake Powell should form one of the elements of this assessment. Similarly, Reclamation and the Park Service must create a plan for the sediment movement at the Delta of the Colorado River and Lake Powell. Studies must be in place to decide how and what to do with the "glacier" of fine sediment working its way into the canyon.	This SEIS covers only the remainder of the interim period, through 2026. A long-term sediment management plan is outside the scope of this SEIS. We encourage you to provide comments on this issue for the Post-2026 EIS.
302	4	HYDROLOGY - HYDROLOGY	* Despite the short-term nature of this SEIS, persistent aridification due to higher temperatures and long-term declines of water availability in the basin should be used as the correct baseline assumption for the present hydrology, not only cyclical and temporary "drought" conditions (See the table next page of recommended science journals to help determine the appropriate baseline assumptions) * For example, to determine a realistic best case hydrology of water flowing into Lake Powell for the next three years, the present 30-year average of 9.6 million acre-feet per year would be reasonable analysis to educate the public.	The hydrologic modeling examines scenarios based on flows in the Basin over the past 30 years, which includes the driest 23-year period on record. To examine even worse drought conditions, the hydrologic modeling examines Basin flow scenarios with 90 percent and 80 percent of the flows seen over the past 30 years (up to a 20 percent reduction in flows compared with the last 30 years).
302	5	HYDROLOGY - HYDROLOGY	To determine a possible worst case hydrology in the next three years, a reduction of 40% from the 30-year average is also an acceptable assumption, because that was the hydrology that initiated the EIS for shortage criteria in 2005.	The hydrologic modeling examines scenarios based on flows in the Basin over the past 30 years, which includes the driest 23-year period on record. To examine even worse drought conditions, the hydrologic modeling examines Basin flow scenarios with 90 percent and 80 percent of the flows seen over the past 30 years (up to a 20 percent reduction in flows compared with the last 30 years). Through the SEIS we are proposing operational changes to protect critical elevations.
302	6	HYDROLOGY - HYDROLOGY	The start date for modeling the alternatives begins on June 1, 2023 after the reservoir elevation at Lake Powell had already increased by 40 feet. The start date should have been 3,490 feet, which is the minimum reservoir level for hydropower production.	The model was initialized with current conditions which is based on Reclamation's Colorado River SOP for the EIS.

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302	10	HYDROLOGY - HYDROLOGY	We do agree that the water problems of the Colorado River Basin are deep and mired. However, we do not think the future is uncertain. For example, we already understand the system will be operating in the 10th percentile for the rest of the century on average even if some wet years occur, that no further voluntary reductions from the states will be forthcoming, and the weaknesses in the legal foundations and the infrastructure are creating lose-lose outcomes where water availability for human needs and hydropower will both decline along with the health of the river basin ecosystem. Meanwhile Reclamation arbitrarily tinkers with its modeling to predict a rosy outcome.	The only procedure that differed from Reclamation's standards was the 80% and 90% traces which were created to analyze drier conditions than the 30-year record.
302	11	HYDROLOGY - HYDROLOGY	In this revised draft SEIS, Reclamation has narrowed the "hard look" standard of the National Environmental Policy Act (NEPA). The hydrology of 2023 was misrepresented to the public, progressive aridification in the Basin was again ignored, and the assumptions used for this analysis are unsupported.	The hydrologic modeling examines scenarios based on flows in the Basin over the past 30 years, which includes the driest 23-year period on record. To examine even worse drought conditions, the hydrologic modeling examines Basin flow scenarios with 90 percent and 80 percent of the flows seen over the past 30 years (up to a 20 percent reduction in flows compared with the last 30 years).
306	6	HYDROLOGY - HYDROLOGY	P. 3-20: "As stated in the 2007 FEIS, this reach includes the Grand Canyon, which limits the hydraulic connection to groundwater. The Stream Flow and Losses of the Colorado River in the Southern Colorado Plateau White Paper 5 (White Paper 5) (Wang, J. and Schmidt, J. 2020) states that approximately 150,000 af/yr are lost as seepage around the Glen Canyon Dam." The next paragraph of the Wang and Schmidt (2020) white paper states: "Downstream from Lees Ferry, there is significant intervening inflow whose sources are springs within the Grand Canyon. Between 1990 and 2018, ~770,000 af/yr entered the Colorado River, of which only 17% came from the Paria River and the Little Colorado River upstream from Cameron. Since 2007, more than 600,000 af/yr has come from springs within the Grand Canyon. On average, ~170,000 af/yr has its source in springs in the downstream end of the Little Colorado River Canyon. Downstream from the Grand Canyon gage, intervening inflows to the Colorado River have been ~390,000 af/yr since 2007. The impacts of proposed ground-water development and the effects of decreased precipitation in the Grand Canyon region have the potential to decrease the amount of spring-fed intervening flows that augment the releases from Glen Canyon Dam in maintaining water storage in lake Mead."	CRMMS assumes gains between Glen Canyon and Hoover and includes contributions and losses from GW and other sources. CRMMS relies on the historical calculated Lower Basin gains and losses for intervening flows between Glen Canyon Dam and Hoover Dam. The calculated gain/loss includes any historical groundwater contributions in this reach, in addition to inflows from the Paria and Little Colorado Rivers.
306	7	HYDROLOGY - HYDROLOGY	P. 3-22: What are the daily release patterns of Hoover Dam? Is there a clear depiction or reference to those daily release patterns in this document?	This SEIS analyzes annual and monthly releases. Daily releases are not within the scope of this document.
306	9	HYDROLOGY - HYDROLOGY	Pp. 3-54-5: Groundwater impacts. Are there any opportunities to enhance groundwater storage in the Lake Powell basin? Stored groundwater would not be lost to evaporation and could be recaptured at lower reservoir levels.	Thank you for your comment. This is outside the scope of this SEIS.
306	22	HYDROLOGY - HYDROLOGY	P. 3-197: The statement that "...backwaters are rare and ephemeral habitats..." downstream from Glen Canyon Dam is now true, but only because of the way the river is being managed. From observing river geomorphology the decade after dam closure, and the effects of very high flows in the mid-1980s (e.g., Stevens et al. 1995), it is abundantly evident that backwater habitats were common features in the wide reaches of the river, and that reduced dynamism of flow by the dam has virtually eliminated these important aquatic habitats.	Than you for your comment.

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310	5	HYDROLOGY - HYDROLOGY	Table 1-1, "Resources Considered for Detailed Analysis" (p. 1-13, RSDEIS), needs to include ecological flows as a resource or as part of the Hydrologic Resources and Water Deliveries Resources and should be analyzed throughout the RDSEIS. Ecological flows are an important function of the Colorado River and have been greatly diminished, if not nearly eliminated, under current river management regimes. The impact of these dam-and-reservoir management regimes on the essential function of the Colorado River in providing ecological flows needs to be assessed, and the Proposed Action needs to consider to what degree ecological flows can be implemented under the current or Proposed Action river management regimes.	Ecological flows have not been assessed and established for the entire Colorado River. The purpose and need of this SEIS is to modify the existing 2007 Interim Guidelines for operation of Glen Canyon and Hoover Dams to address historic drought, historically low reservoirs, and low-runoff conditions in the Basin, leading to the potential for critically low reservoir elevations. Please refer to section 3.13 for additional information on biological resources. This issue is addressed further in the LTEMP SEIS as it relates to flows through the Grand Canyon.
310	31	HYDROLOGY - HYDROLOGY	The statement "Major tributaries to the Colorado River include the Green, San Juan, Yampa, Gunnison, and Gila Rivers." (RDSEIS, p. 1-2) is partially incorrect. The Gila River is no longer a major tributary of the Colorado River and has not been for decades. At most, a trickle of local field runoff flows from the Gila into the Colorado. Until this year, the last significant flow into the Colorado from the Gila occurred in 1993. When there is a significant flow in the Gila, as there is right now, it results from releases from dams on the Verde and Salt Rivers, which the Salt River Project manages. Please correct the statement to reflect this information.	The Salt and Verde rivers are tributaries to the Gila River and are reasonably considered as Gila River flows. When the Gila River does provide inflow, it qualifies as major. There are past events of major Gila River inflows within the analysis period for this SEIS.
326	8	HYDROLOGY - HYDROLOGY	Concurrent to this process, the Service is also consulting with Reclamation on a SEIS analysis of flow regimes (high flow experiments) under LTEMP to deter non-native smallmouth bass reproduction below Glen Canyon dam and to increase sediment flow windows. The Service is also consulting with Reclamation on an EIS on the Development of Post-2026 Operational Guidelines and Strategies for Lake Powell and Lake Mead. The post-2026 NEPA process will revisit all sections of the 2007 Interim Guidelines and other domestic operating agreements to guide operations in a wide range of future conditions beyond 2026. Further, through the consultation process on this SEIS, the Service and Reclamation have agreed that greater analyses will be completed during this full EIS process on post-2026 operations. This SEIS to develop near-term Colorado River operation options and address extreme drought conditions during the 2024-2026 timeframe does not update the baseline information for any of the federally listed species and instead relies on the historic baseline as described in the 2005 LCR MSCP Biological/Conference Opinion and the 2007 Interim Guidelines. The Service anticipates that the post-2026 NEPA process will update all baseline conditions. The Service also anticipates working closely with Reclamation and the 57 LCR MSCP partners during the post-2026 process to determine appropriate analyses and any needed steps to re-issue the 10(a)1(B) permit if an amendment to that permit is needed.	Thank you for your comment. Reclamation appreciates the input from the U.S. Fish and Wildlife Service on each of these processes.

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326	11	HYDROLOGY - HYDROLOGY	[Section 2.1, Table 2-9, pages 2-23] Summary of Potential Effects of the Alternatives states that the No Action alternative results in slightly higher to substantially higher flows in the river than the Proposed Action alternative. As related to the alternatives, quantification of the difference between these no action flows and the action alternatives is needed. Specifically, information is needed for projected minimum releases including flow rate, seasonal timing, duration, and related river stage elevation decreases due to additional decrease of flow rates.	This table summarizes the results that are further analyzed in Chapter 3.
326	19	HYDROLOGY - HYDROLOGY	[Section 2.5, page 2-3, second paragraph] The SEIS notes that in times of Lake Powell falling below the critical elevation of 3,490 that it would be operating with 3 of 4 river outlet works. Suggest acknowledging potential issues with cavitation anticipated under that scenario.	Out of scope for this SEIS.
326	20	HYDROLOGY - HYDROLOGY	[Section 2.7, page 2-7] 1st paragraph under Proposed Action, last sentence, should that read Lake Mead and Lake Powell? The next paragraph states under most scenarios (but not all) there wouldn't be a change in how Lake Powell is operated - but there are scenarios where there could be a change.	Yes, it is possible for operations to change at Lake Powell, but system conservation is specific to the Lower Basin.
326	51	HYDROLOGY - HYDROLOGY	[Section 3.13.2, page 3-198] Conflicting sentences about the No Action alternative. "Releases from Lake Mead would remain the same," and "flows [from Hoover Dam to the SIB] would be lower." Please resolve.	There is no conflict between these sentences. The first refers to the allowable releases under the No Action alternative. The second indicates that drought could eventually impact releases and resulting flows.
326	56	HYDROLOGY - HYDROLOGY	[Section 3.3.3, lines 7-11, page 3-4] The footnote specifies that the ESP traces are based on an ensemble of unregulated streamflow forecasts from NWS. Add explanation of why unregulated flows are representative for this system either here or in Appendix D.	Page D-5 describes this. CBRFC unregulated inflow forecasts allow us to use our water management models to solve for operations in reservoirs, since unregulated flows assume no regulation from dams upstream of the forecast location.
326	57	HYDROLOGY - HYDROLOGY	[Section 3.6, page 3-22] Second to last paragraph. SEIS states that the proposed alternative will not change how Hoover Dam is operated on an hourly and daily basis as long as sufficient water is available. Could you add more detail about what is (or where to find) the volume or flow considered "sufficient"? And add where to find information on how hourly and daily operations will change when water is not "sufficient".	Hourly and daily operations are outside of the scope of the SEIS.
326	58	HYDROLOGY - HYDROLOGY	[Section 3.6.1 Hydrologic Resources, page 3-23] Provide information on projected minimum releases for Parker Dam and Davis Dam including flow rate, seasonal timing, duration, and related river stage elevation decreases due to additional decreased flow rates.	Minimum flow rates, seasonal timing, and duration do not change as a result of the proposed action. Minimum flow rates will continue to be consistent with the Standing Operating Procedures for Davis Dam and Parker Dam and seasonal timing/duration will continue to be based on seasonal trends for water orders. Any impacts to related river stage elevations are considered in analysis for the Biological Assessment.
326	60	HYDROLOGY - HYDROLOGY	[Section 3.6, page 3-23] Pages 3-23 through 3-26 contain valuable discussion on potential affects to Dam operations below Hoover Dam. Each section contains a good history of average operation since implementation of the 2007 Interim Guidelines, including minimum annual, daily and hourly releases. Please add information on anticipated minimum annual, hourly and daily releases under the worst case flow reductions allowed under the proposed action. This information would be very valuable in understanding potential impacts at diversion points for National Wildlife Refuges and Conservation Areas.	Hourly and daily operations are outside of the scope of the SEIS. Minimum annual releases from Mead are discussed in terms of annual lower division state depletions.

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326	63	HYDROLOGY - HYDROLOGY	[Section Appendix D, page D-1] Please provide background on the CBRFC inflow forecasts that are a foundational input to the hydrologic analysis and study including uncertainty and limitations.	D-5 describes these forecasts. Uncertainty of forecasts is addressed in D-4 (d.2.2)
484	1	HYDROLOGY - HYDROLOGY	Hydrology and Current Conditions While hydrology improved in 2023, the risks of declining below critical elevations in Lake Powell and Lake Mead persist. Significant uncertainty continues in the Colorado River system. This is evidenced by the comparison between the projected inflows in April 2023 and the actual observed inflows at the end of Water Year 2023, which showed a decline of about 1.0 million acre-feet (maf). Most recently, Reclamation has reported an approximate 776,000 acre-foot drop in forecasted Lake Powell inflow between the October and November 24-Month Studies. Clearly, one good runoff will not recover the Colorado River system after enduring 23 years of drought and overuse in the Lower Basin. Continued dry conditions in conjunction with the imbalance between available supply and demand in the Lower Basin will result in the Colorado River system remaining destabilized, the condition the SEIS is intended to address. Moreover, reservoir conditions have not improved sufficiently to warrant the change in action and approach from the First Draft SEIS to the Revised Draft SEIS. Currently, Lake Powell is 37% full and Lake Mead is 34% full. Although Lake Powell gained approximately 50 feet during WY 2023, recent history demonstrates that Lake Powell can just as easily fall 50 feet in a single year (see WY 2021). In fact, Reclamation's current modeling shows a risk of declining to critical elevations in Lake Powell by the end of 2024. In June 2022, when Commissioner Touton called for 2 to 4 million acre-feet per year of water conservation in response to a failing system, Lake Powell was approximately 27% full and Lake Mead was approximately 28% full. The risk to the system has not abated. Therefore, the urgency remains today; the improved hydrology of WY2023 has not solved the problem. It is not clear that the Proposed Action will be sufficient if dry hydrology persists.	Reclamation agrees that significant uncertainty continues, which is why this SEIS continues to be needed to create tools to address low reservoir conditions. The SEIS covers operations through 2026. Any changes in hydrologic conditions beyond what was analyzed for SEIS would be included in the Post-2026 EIS. Reclamation recognizes that the hydrology has declined since the modeling was redone based on June 2023 numbers, but it is still within the range shown in the graph from the Final SEIS Dear Reader Letter. As explained in the Dear Reader Letter to the Revised Draft SEIS, Reclamation analyzed the Lower Division Proposal (now the Proposed Action) at the request of the Seven Basin States, and that analysis shows that the Proposed Action balances the risk between Lake Mead and Lake Powell better than the alternatives considered in the Original Draft SEIS. The current range of alternatives thus meets the purpose and need to address low reservoir conditions across the Basin in the short term and, perhaps more importantly, provides the space "so that all parties can focus their resources on the development of the post-2026 guidelines" as described by the Seven Basin States.

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484	3	HYDROLOGY - HYDROLOGY	The Revised Draft SEIS does not specify what portion of compensated system conservation, if any, is included in mandatory shortages and reductions required by the 2007 Interim Guidelines and Lower Basin DCP. The 3.0 maf reductions should be in addition to those mandatory shortages and reductions. Finally, a significant amount of the reduction in Lower Basin use in 2023 occurred as a result of reduced demand due to abnormally wet hydrology and not due to conservation activities. The 3.0 maf of system conservation should not include reduced releases from Lake Mead resulting from wet hydrology. For example, Reclamation reports that the impact of Hurricane Hilary increased Lake Mead elevations by several feet due to runoff and reduced uses. Reclamation must provide clear, consistent, and transparent accounting of what constitutes new and additive conservation efforts rather than fortuitous hydrologic events.	Section 2.7 of the SEIS states that SEIS conservation, or compensated system conservation, is in addition to mandatory reductions under the 2007 Interim Guidelines. Reduced releases from Hoover Dam do not count toward the 3.0 maf of SEIS conservation. However, SEIS conservation may include creation of ICS, as the Basin States agreed to analyze in this SEIS. Good hydrology benefits the entire Basin. It has, among other things, increased Upper Basin reservoir levels, facilitated recovery of DROA volumes, and enabled meeting seasonal targets at Flaming Gorge and Aspinall Reservoirs. And, when this process began, a 9.5 maf release was projected, but this was able to be reduced to 8.58 maf due to the improved hydrology. Lake Mead released the lowest amount in 30 years (7.491 maf, the lowest since 1993). The total current projected use is 5.81 maf, which is the lowest Lower Division State total consumptive use since 1982. All of these factors promote higher elevations in Lake Powell and Lake Mead, which under the Guidelines we have for the interim period, are benefits to the entire basin. For example, if operations did not account for improved hydrology conditions, the result would be additional releases from Lake Powell, regardless of Lower Basin hydrology. Reclamation has always made its data and accounting available. It is the same type of accounting that has been done for decades, pursuant to the Supreme Court Decree, and the same type of accounting done since 2007. It is publicly available and transparent, and Reclamation has offered to provide technical assistance to increase understanding.
109	2	INDIANTRST - Indian Trust Assets	The Nation has reviewed the Draft SEIS with particular focus on the section related to Indian Trust Assets (ITAs). The Nation is encouraged by the BOR finding that there are no significant impacts to ITAs from the preferred alternative. One of the assets held by the Nation pursuant to its water settlement is an Indian priority Central Arizona Project contract with the BOR for 13,933 AF. The Nation wishes to remind the BOR, in the context of this Draft SEIS and future Colorado River federal actions, that the assets gained through the Nation's settlement were the result of negotiation and concession with the certainty that the assets would be available for all time. It is the BOR's responsibility to ensure that water settlement assets are available in the future and that Tribe's are treated equitably with respect to equitable ITAs.	Reclamation acknowledges the Fort McDowell Yavapai Nation's congressionally approved water rights settlement and Reclamation's obligation to carry out any trust obligations consistently with congressional directives and settlement terms.

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115	4	INDIANTRST - Indian Trust Assets	The Draft SEIS provides a conclusory statement about Indian reserved water rights: "Tribal water rights are established by settled law." Sec. 2.10, p. 2-35; Sec. 318, p. 3-331, 333. The Draft SEIS acknowledges the Indian water rights of tribes in the Lower Basin under Arizona v. California (1963) and recent Congressional settlements of a couple of tribes. But the Department's conclusion regarding any obligation to evaluate the adverse impact of its decisions on tribal water rights remains the same--these rights are established by law. However, what does this conclusory statement mean for the current decisions, policymaking, and processes facing tribes and other governmental entities and their water users in the Colorado River Basin? The Federal Government declined to describe and explain the settled law related to federal, Indian reserved water rights in the context of the current SEIS activities. The Indian water rights law is separate from and unique to theLaw of the River, and is not part of the System water used by the states. The follow-up explanation provided by Reclamation states that annual water deliveries may change as a result of shortages. It is axiomatic that there is ambiguity and confusion among tribes, the Department, and the states regarding what the settled law means (as evidenced, e.g., in numerous extended litigation engaged in by the Department with particular tribes). The Draft SEIS has an insufficient articulation of Indian water rights, the rights of tribes, and the role of the Federal Government as trustee of these tribal trust assets. Tribes deserve, are legally entitled to, and must receive a more detailed articulation of how the Federal Government is managing the River to their benefit and whether the Federal Government's actions will adversely affect these rights, than such a limited statement from the Federal Government provides related to its obligations and responsibilities in the Colorado River Basin to tribes. The Department is obligated to address the issues in the Colorado River under two unique bodies of law: (1) Federal Indian reserved water rights law, "Indian Water Rights" Law; and (2) the "Law of the River." [See comment letter for additional details.]	The Draft SEIS concerns operations at Lake Powell and Lake Mead. The tribes have a variety of water rights across the Basin with unique characteristics. A detailed discussion of these rights is not required unless it is related to operations within the scope of the SEIS. Some tribes may choose to participate in the voluntary system conservation opportunities described in the Proposed Action. Such participation is voluntary and does not affect any Tribe that does not want to voluntarily participate. The voluntary conservation would also increase reservoir levels compared with the No Action alternative, making mandatory shortages under the 2007 Interim Guidelines less likely.
115	5	INDIANTRST - Indian Trust Assets	We focus on two critical issues here: (1) the failure of the Federal Government to account for our Tribe's senior, Indian reserved water rights in the evaluation and analysis activities for the Draft SEIS; and (2) the failure to compensate tribes, such as ours, for conserved and unused Indian water that flows downstream and are relied on to fill Lake Powell. [See comment letter for additional details.]	The Draft SEIS concerns operations at Lake Powell and Lake Mead. The tribes have a variety of water rights across the Basin with unique characteristics. A detailed discussion of these rights is not required unless it is related to operations within the scope of the SEIS. Some tribes may choose to participate in the voluntary system conservation opportunities described in the Proposed Action. Such participation is voluntary and does not affect any Tribe that does not want to voluntarily participate. The voluntary conservation would also increase reservoir levels compared with the No Action alternative, making mandatory shortages under the 2007 Interim Guidelines less likely.

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310	14	INDIANTRST - Indian Trust Assets	Reclamation must address the Guiding Principles in the Colorado River Basin Tribal Coalition's letter and work collaboratively in partnership with the Tribes. The U.S. government must fulfill its trust responsibility to Tribes and resolve water rights for the twelve Tribes whose water rights remain unsettled and must assist Tribes in finding ways to provide safe water to all Tribal members. The current drought should not be used as an excuse to further delay these processes; quite the opposite: the need to provide every person with safe clean drinking water is now more urgent than ever. The COVID-19 crisis, which disproportionately affected Tribal members in the Southwest because of their lack of access to adequate water supplies, tragically reinforced the need for everybody to have access to reliable, clean water. Where the U.S. government and others are benefitting from the use of unallocated water to Tribes, those Tribes should be compensated so they can work toward achieving equitable water supplies for all their members.	Reclamation continues to work on settling tribal water rights. The drought does not delay that process. Reclamation is committed to the discussion of tribal water rights claims with individual tribes that is beyond the short timeframe covered by this SEIS, and consultation is ongoing.
310	15	INDIANTRST - Indian Trust Assets	Reclamation needs to cooperatively work to provide for the needs and values of Tribes and Tribal members, including what are commonly referred to as non-use values: flowing water, ecosystems, and springs may hold importance for Tribal members of which the Bureau is unaware. While we appreciate that Reclamation recognizes these values exist and are under application to be recognized as Traditional Cultural Properties, including the Colorado River and its tributaries and canyons (RDSEIS, p. 3-151 to 3-152), the values and rights that Native Americans hold regarding rivers and natural features need to be incorporated into the RDSEIS analysis of effects of implementing the No Action Alternative and the Proposed Action.	Reclamation is currently working with Tribes to develop a programmatic agreement for the SEIS to ensure concerns regarding historic properties important to Tribes and their cultural values are addressed. Further consideration of Tribal values will be discussed in greater detail in the Post-2026 Interim Guidelines EIS to be prepared in 2024, as well as the development of a Post-2026 Interim Guidelines programmatic agreement in consultation with the Tribes. In addition, as discussed in Section 18, Indian Trust Assets, of the SEIS, the Proposed Action may result in decreased water deliveries to Tribes which have agreed to voluntary conservation measures but would not affect the underlying tribal water rights to Colorado River water.
314	6	INDIANTRST - Indian Trust Assets	Tribal water rights and Indigenous Traditional Ecological Knowledge need to be prioritized in all management decisions. The SEIS indicates that neither alternative would impact established water rights yet is silent on how conditional or unquantified water Tribal Water Rights have the chance to be effected. Tribes have some of the most senior water rights on the Colorado River, yet they have been left out of management decisions since those water rights were established. Joint Secretarial Order No. 3403 directs agencies with the Department of Interior to collaborate with Indian Tribes on decision making affecting management of Federal lands and waters. As Reclamation incorporates alternative management scenarios from Basin States, any proposed alternatives that have not considered the development of unperfected Tribal water rights and have not included thorough collaboration with affected Basin Tribes, should not be considered a complete alternative. Any proposed water allocations and reductions in interim operations need to fully analyze impacts to both developed and undeveloped Tribal water rights.	Tribal consultation is ongoing to address Tribal impacts and incorporate Traditional Ecological Knowledge. Reclamation continues to work on settling tribal water rights and addressing other tribal water claims. Reclamation is committed to the discussion of tribal water rights claims with individual tribes that is beyond the short timeframe covered by this SEIS, and consultation is ongoing.

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320	1	INDIANTRST - Indian Trust Assets	While we are pleased with the improved hydrology in the Colorado River Basin, we urge Reclamation to not lose sight of its statutory trust responsibility to protect, develop, and defend Tribal water resources. Regardless of which Alternative Reclamation ultimately adopts, Reclamation should ensure any and all reductions to Tribal statutory water entitlements are voluntary and compensated or replaced. Reducing the dependence of Tribes on the Colorado River is an important objective for Reclamation to consider throughout this process. This is especially true for Tribes, like the Community, with congressionally enacted water settlements with statutorily protected water resources. See Arizona Water Settlements Act ("AWSA") SS 204(a)(2), Pub. L. 108-451, 118 Stat. 3502 (2004).	All water reductions to tribes are voluntary under the Proposed Action. Some tribes may choose to participate in the voluntary system conservation opportunities described in the Proposed Action. Such participation is voluntary and does not affect any Tribe that does not want to voluntarily participate. The voluntary conservation would also increase reservoir levels compared with the No Action alternative, making mandatory shortages under the 2007 Interim Guidelines less likely.
320	3	INDIANTRST - Indian Trust Assets	The Community has one criticism of the Revised Draft SEIS that I only raise because it is significant to the Community. During our government-to-government consultation with Reclamation this Spring, one of our specific criticisms of the original draft SEIS was its failure to adequately describe the nature of the trust asset that is the Community's CAP entitlement of 311,800 acre-feet of Colorado River water per year. Chapter 3 of the Revised Draft SEIS describes the affected environment and environmental consequences for the resources that could be significantly affected by the Alternatives. Section 3.18 of the Revised Draft SEIS is titled "Indian Trust Assets" which implies that all Tribal water rights discussed under the section, both Arizona v. California 2006 Consolidated Decree rights and CAP entitlements, are considered Indian Trust Assets ("ITAs") without distinction. The Community continues to be dismayed with Reclamation's apparent inability to acknowledge that most, if not all, CAP entitlements come from water rights settlements that have specific statutory language establishing CAP water as a trust asset, which creates specific obligations for the United States in terms of the protections it must provide for such water resources, or else face liability under established U.S. Supreme Court precedent regarding trust responsibilities.1 For example, Section 204(a)(2) of the Gila River Indian Community Water Rights Settlement Act of 2004 (a part of the AWSA) expressly states that "[t]he water rights and resources described in the Gila River agreement shall be held in trust by the United States on behalf of the Community and the allottees as described in this section."2 AWSA § 204(a)(2), Pub. L. 108-451, 118 Stat. 3502 (2004). The Community is very concerned with how Reclamation characterizes these different rights in the Revised Draft SEIS. As the draft currently reads, Section 3.18 (page 3-331) has a heading for Arizona v. California water rights titled "Indian Trust Assets Determined under Arizona v. California" but the heading for CAP water rights merely says, "Central Arizona Project." Nowhere in the body of the Revised Draft SEIS are CAP rights identified as Indian Trust Assets or ITAs. By not specifically acknowledging CAP Tribal entitlements as ITAs the Revised Draft EIS fails to adequately describe Reclamation's statutory trust responsibility to Tribes, like the Community, that have statutory trust entitlements to Colorado River water delivered through the CAP to satisfy claims to senior water rights. This either demonstrates Reclamation's failure to understand the significance of these specific "trust" provisions in water rights settlement legislation, or a purposeful effort to diminish the significance of these provisions. Given our strong partnership with Reclamation, the Community believes it is the former and we hope this can be easily addressed with edits to the Revised Draft SEIS. We strongly	All water reductions to tribes are voluntary under the Proposed Action. Some tribes may choose to participate in the voluntary system conservation opportunities described in the Proposed Action. Such participation is voluntary and does not affect any Tribe that does not want to voluntarily participate. The voluntary conservation would also increase reservoir levels compared with the No Action alternative, making mandatory shortages under the 2007 Interim Guidelines less likely.

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320 *(cont.)*	3 *(cont.)*	INDIANTRST - Indian Trust Assets *(cont.)*	believe that Section 3.18 should be revised to clarify the nature of Tribal entitlements to CAP water that are included in congressionally-approved water settlements. Ideally, Reclamation should list out the water rights settlement legislation for CAP Tribes, like it did under Section 3.10.1.2 of the 2007 FEIS (Reclamation 2007), with a specific citation to each provision in each water rights settlement legislation that expressly identifies these water rights as trust assets held by the United States. If that is too cumbersome, we respectfully insist that the heading and paragraph describing CAP Tribal entitlements in Section 3.18 read as follows: Central Arizona Project Indian Trust Assets Tribal entitlements to CAP water and/or non-CAP Colorado River water delivered through the CAP in central Arizona are administered pursuant to water delivery contracts between Tribes and the Secretary. A summary of water rights settlements as of 2007 is presented in Section 3.10.1.2 of the 2007 FEIS (Reclamation 2007), and water rights for the CAP Tribes as of 2007 are summarized in Table 3.10-2, Central Arizona Project Indian Tribal Diversion Entitlements (Water Rights) (Reclamation 2007). As of 2023, water rights settlements approved by an Act of Congress involving CAP water have been executed with the Ak-Chin Indian Community, Fort McDowell Yavapai Nation, Gila River Indian Community, San Carlos Apache Tribe, Salt River Pima-Maricopa Indian Community, Tohono O'odham Nation, Yavapai-Prescott Indian Tribe, Hualapai Tribe, and White Mountain Apache Tribe. The statutes approving these water rights settlements include a provision that expressly holds water rights and resources, including CAP water, in trust by the United States. CAP water is also retained for a future water rights settlement agreement approved by an Act of Congress that settles the Navajo Nation's claims to water in Arizona.	*(See above.)*

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380	6	INDIANTRST - Indian Trust Assets	Address Historic Inequities Executive Order 14096 directs agencies to identify, analyze, and address historical inequities and systemic barriers related to any federal regulation, policy or practice that impairs the ability of Tribes who may have environmental justice concerns to achieve or maintain a healthy and sustainable environment. We note that Reclamation collaborated with the Ten Tribes Partnership in 2018 to document Tribal water use and potential future development to better facilitate planning and decision-making throughout the Basin. The Colorado River Basin Ten Tribes Partnership Tribal Water Study3 found that partnership Tribes have reserved water rights, including unresolved claims, to divert nearly 2.8 million acre-feet of water per year from the Colorado River and its tributaries. These rights are, in general, the most senior water rights in the Basin and therefore some of the most protected from shortage; however, the Study recognizes that many people living on the Tribal reservations do not have water security and may lack access to clean water and adequate sanitation on Tribal lands (Study p. 9-1). The Study includes recommendations to increase development of water rights for Tribal benefit, address the administrative and legal constraints that create disparities in water development and use, and to provide flexibility in the use of Tribal water throughout the Basin. The Study states that Reclamation will work with partnership Tribes to identify near-term activities to help address the water challenges in the Basin (Study pgs. 9-2/3). It is unclear from Draft SEIS whether Reclamation has identified and addressed these concerns and observations in the current Proposed Action. Recommendations: In sections that discuss Tribal reserved water rights or trust assets, identify, analyze, and address historic inequities and systemic barriers related to development of and access to Tribal water. Summarize or reference the findings and recommendations of the Colorado River Basin Ten Tribes Partnership Tribal Water Study into the Final EIS. Identify near term activities or mitigation that will assist Tribes with unsettled rights to receive water or be compensated for the use of the Tribal water right, including any current programs or funding opportunities specifically designed to correct or remove inequities or barriers, improve water resiliency, or develop or maintain infrastructure. 3 Tribal Water Study Report; https://www.usbr.gov/lc/region/programs/crbstudy/tws/finalreport.html	Reclamation continues to work on settling tribal water rights and tribal infrastructure development with affected individual tribes. Reclamation is committed to the discussion of unallocated tribal water with individual tribes that is beyond the short timeframe covered by this SEIS, and consultation is ongoing.
410	2	INDIANTRST - Indian Trust Assets	While this projected outcome is fortuitous for the Nation, it is primarily the product of an indirect benefit " compensated conservation for a narrow subset of Colorado River water users other than the Nation" rather than a conscious effort on Reclamation's part to prioritize its responsibility to protect the Nation's settled and unsettled federal reserved water rights. Similar to the draft SEIS, the Revised DSEIS employs an artificially narrow definition of "Indian Trust Assets" thus failing to take the full scope of impacts to the Nation's rights into account. Moreover, the Revised DSEIS continues avoid addressing critical aspects of the Nation's water settlement by failing to address Reclamation's responsibility to ensure that the Nation will continue to receive its full water delivery entitlement in the event of shortages.	Any reductions in water deliveries, including to Tribes, under the No Action would be based on established priorities. Decreased deliveries to Tribes under the Proposed Action would be only for those Tribes who are voluntarily participating in conservation measures. There would be no changes under either alternative to settled water rights.

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619	2	INDIANTRST - Indian Trust Assets	In summary, while the Bureau of Reclamation has repeatedly stated its intent to adhere in this process to the trust responsibility that the United States has to tribes, and has in an admirable manner engaged in open and transparent consultations with affected tribes, the Bureau has thus far failed to insist that any reductions in Colorado River water deliveries - however made - be accomplished without reducing the amounts of water allocated to Indian tribes in congressionally approved water settlements, absent tribal consent to such reductions. In other words, while the Bureau's consultation process has been exemplary, the substance has been woefully lacking. The Bureau has thus far failed to address the very real substantive problem that, without active intervention by the Secretary to protect the amounts of water allocated to the tribes in congressionally approved water right settlements, those tribal allocations will likely experience involuntary and uncompensated shortages after 2026 so long as the current long-term drought in the Southwest continues. In the view of the Hualapai Tribe, the Secretary's obligation to safeguard these congressionally approved tribal water rights from involuntary reductions is an irrevocable and binding requirement of the United States' trust responsibility that should be insisted upon by you and by Secretary Haaland as the Tribes' trustees. Below, in Section III, we describe the water needs of the Hualapai Tribe and the Tribe's water rights settlement ratified by Congress last year. Then, in Section IV, we discuss the protections that the federal trust responsibility requires you and Secretary Haaland to secure for the Tribe's congressionally approved water rights enshrined in its settlement, and take similar actions to protect the amounts of water allocated to other Arizona tribes in congressionally approved water settlements. [See comment letter for additional details]	Any reductions in water deliveries, including to Tribes, under the No Action would be based on established priorities. Decreased deliveries to Tribes under the Proposed Action would be only for those Tribes who are voluntarily participating in conservation measures. There would be no changes under either alternative to settled water rights.
619	3	INDIANTRST - Indian Trust Assets	The major deficiency in the Bureau's consideration of how to deal with shortages in the Colorado River thus far has been its failure, as an indispensable part of its plan for future Colorado River operations, to concentrate upon protecting the security of Colorado River water allocated by congressionally approved water settlements to Arizona tribes, including the Hualapai Tribe. As in the draft SEIS that we commented on last June, the Section in the Revised draft on Indian trust assets is cursory and overly general. While it mentions, at pp. 331-32, that the Hualapai Tribe's reserved water rights have been settled in the Hualapai Tribe Water Rights Settlement Act of 2022 and is thus a "trust asset," it does not provide any alternatives for the Secretary to take action to protect these rights from being drastically reduced or even eliminated entirely in future shortages. Similarly, while Section 3.17 on Environmental Justice acknowledges that federally recognized tribes are considered "environmental justice populations," pp. 3-13, the Section does not contain any discussion or analysis of specific steps the Secretary might take to protect the reserved water rights of those tribes in congressionally approved settlements from being curtailed by the Secretary's operation of the Lower Colorado River in times of shortages. The major deficiency in the Bureau's consideration of how to deal with shortages in the Colorado River thus far has been its failure, as an indispensable part of its plan for future Colorado River operations, to concentrate upon protecting the security of Colorado River water allocated by congressionally approved water settlements to Arizona tribes, including the Hualapai Tribe. As in the draft SEIS that we commented on last June, the Section in the Revised draft on Indian trust assets	Any reductions in water deliveries, including to Tribes, under the No Action would be based on established priorities. Decreased deliveries to Tribes under the Proposed Action would be only for those Tribes who are voluntarily participating in conservation measures. There would be no changes under either alternative to settled water rights.

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619 *(cont.)*	3 *(cont.)*	INDIANTRST - Indian Trust Assets *(cont.)*	is cursory and overly general. While it mentions, at pp. 331-32, that the Hualapai Tribe's reserved water rights have been settled in the Hualapai Tribe Water Rights Settlement Act of 2022 and is thus a "trust asset," it does not provide any alternatives for the Secretary to take action to protect these rights from being drastically reduced or even eliminated entirely in future shortages. Similarly, while Section 3.17 on Environmental Justice acknowledges that federally recognized tribes are considered "environmental justice populations," pp. 3-13, the Section does not contain any discussion or analysis of specific steps the Secretary might take to protect the reserved water rights of those tribes in congressionally approved settlements from being curtailed by the Secretary's operation of the Lower Colorado River in times of shortages. The Department has a trust responsibility to protect these congressionally approved water allocations to tribes, which quantify the tribes' water rights under the well-established Winters doctrine. The water allocated to tribes in these settlements is generally taken into trust for the tribes under statutes ratifying the settlements. As discussed below, these tribal water rights have a priority that, under the landmark Winters Supreme Court decision, is senior to virtually all non Indian water rights in the Lower Colorado River Basin. The Hualapai settlement, like many Arizona tribal water rights settlements, relies on CAP water to fulfill tribal water needs promised by the settlement. It bears emphasis that in order to secure Federal, State, and congressional support for these tribal water settlements, the tribes have generally been required to waive all past claims against both the United States and non-Indian water users for past injuries to or encroachment upon the tribes' legally senior water rights, as well as to waive all past claims against the United States for the abject historical failures of the federal government to protect their rights. These waivers constitute major concessions by the tribes because they have allowed legally junior non Indian users to continue to use water to which the tribes, by law, hold a senior legal priority. Because of the historic derelictions of the United States throughout the 20th century in failing to protect tribal water rights, non-Indians have been able to develop long-established water uses that the Hualapai Tribe and other tribes were then forced to recognize in their negotiated water settlements, and then to waive their legal rights to contest those legally junior non-Indian uses in order to obtain the political support from Arizona officials and stakeholders, and from the State's congressional delegation, that was necessary to enact the settlement. [See comment letter for additional details]	*(See above.)*

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619	4	INDIANTRST - Indian Trust Assets	In advancing these comments, the Hualapai Tribe recognizes that our own water rights are not directly affected by decisions you and the Secretary will make concerning near-term operations in 2024 through 2026 because the Tribe's settlement was enacted in December 2022 and will not become enforceable until sometime post-2026, after Congress has fully appropriated the federal funds authorized in the settlement legislation and the Tribe and Department have completed the other preconditions to the enforceability of the settlement. But the Hualapai Tribe nonetheless has an important interest in the current decisions to be made as part of this Revised SEIS, because whatever action the Department takes in this matter will likely serve as precedent for the Department's management of shortages in the Lower Colorado Basin beyond 2026 when the Hualapai settlement will become fully enforceable and the Tribe's allocation of water from the Colorado River will take effect.	Thank you for your comment.
290	3	ISSUESNO - Issues Not Considered in Detail	2.2 (2.8.9) Importation of Water Reclamation received a number of proposals calling for the importation of water (for example, desalinizing and importing water from the Pacific Ocean). These are not considered in detail in this SEIS because the proposals received did not contain sufficient detail to analyze them. Also, they are not actionable during the interim period (before January 1, 2027). Therefore, they do not meet the purpose of and need for Reclamation's action. 2.2.1 My Comment: My proposal, also submitted in previous letter on August 15, 2023, contains sufficient details to analyze them. The BoR is in charge and needs to face the problem and deal with it on time directly to the best of its ability. Minimizing own power and deflecting responsibilities to other departments and making excuses on "not been actionable during the interim period" is a weak argument. Such attitude is a serious problem. By the way, my proposal has nothing to do with several amateurish proposal suggesting importation of seawater with canal and using expensive "reverse osmosis" process for desalinization of the seawater.	As stated in Section 2.8, proposals submitted for importation of water are not actionable during the remainder of the interim period. This SEIS addresses actions to be implemented through 2026, and, in accordance with the stated Purpose and Need (see Section 1.3).
306	17	ISSUESNO - Issues Not Considered in Detail	P. 3-153, 163: Why, with all of the previous discussion of cumulative impacts related to HFEs in the Glen and Grand Canyon reaches, does the topic of impacts related to equalization and balancing flows from Glen Canyon Dam not appear in this document until mid-way through this lengthy chapter? It is widely recognized that reservoir equalization and balancing flows cause the loss of sand from the ecosystem dramatically affecting both the character, natural functionality, and recreational utility of sandbars through Grand Canyon. This is not just an issue for traditional cultural properties, but of great concern to the river running community, the non-using American public, the Hualapai Tribe, and many other groups. Lower reservoir levels mean increased frequency of steady high releases when conditions permit (e.g., during 2011 and the summer of 2023). Such flows devastate the gains made by careful sediment mass balance management. This issue should be more clearly state and mentioned in every Cumulative Impacts discussion.	Equalization and balancing are an operational tier that are evaluated in detail. See Sections 2.6.2 and 2.7.2 for a description of this operational scenario, and Appendix B on how equalization/balancing was addressed the hydrological model. See Section 3.6.2, Issue 3 on how equalization impacts river flows. In terms of sedimentation, equalization is discussed in Section 3.8 Water Quality, noting the erosive impacts.

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284	2	LOWERDIVI - Water Deliveries to Lower Division States	The Districts also support flexibility in how voluntary reductions are achieved. Efforts by the Bureau to micromanage acreage, crops, growing seasons, or specific reductions to entitlements would be detrimental to the Nation's food supply. The Districts and their growers are best positioned to make these types of on-the-ground judgments. With the benefit of their experience and knowledge of local agriculture, the Districts can best manage crop selection, rotation, and allocation of available water supplies for their own fields. Conservation cannot be efficiently achieved through mandated cuts to entitlements or rigid agreements to remove irrigable land from production.	Thank you for your comment.
284	3	LOWERDIVI - Water Deliveries to Lower Division States	Voluntary reductions also allow Colorado River water to be most efficiently allocated among conservation options that support regional agriculture to feed the Nation. Individual growers are best positioned to decide when forgoing their contractual entitlement in favor of compensation is advisable, as well as which crops to grow when and where. Local growers know the value of their crops, and whether the market signals a greater need for conservation than vegetables, or the inverse. Non-voluntary, federal conservation fiats lack the flexibility to achieve this efficient allocation. The value of local decision-making is particularly great for the Districts in Yuma that take advantage of multiple growing seasons, where water deliveries and produce values vary significantly throughout the calendar year. Compensation for conservation needs to play a proper role in the market determination that balances crops against conservation.	Thank you for your comment.
284	12	LOWERDIVI - Water Deliveries to Lower Division States	Where the Districts, Arizona, and Lower Basin States bear the burden of conservation to stabilize the Colorado River system, compensation is both just and necessary. Compensation is fairly offered where entitlement holders forgo their contractual right to divert Colorado River water and implement voluntary conservation instead. Compensation for these voluntary reductions incentivizes conservation and spurs efficient allocation of water usage by all users.	Thank you for your comment.
308	4	LOWERDIVI - Water Deliveries to Lower Division States	BOR explicitly lists public health and safety as one of the primary goals it is trying to achieve by proposing to take action. Yet, the Revised Draft SEIS fails to consider any reasonable and feasible alternatives to allocating shortages that would mitigate the environmental impact of the shortage conditions on communities that would otherwise see their only source of municipal water curtailed down to zero if or when a currently-undefined implementation plan is instituted to protect the Lake Mead elevation of 1, 000 feet. The drought allocation model identifies that Arizona on-river communities such as Lake Havasu City and Bullhead City face shortages of hundreds and thousands of acre- feet respectively, should the total shortage reach the largest levels analyzed. Revised Draft SEIS, Table E- 15. Yet, BOR lays out no analysis of how these identified shortages impact public health and safety, and develops no alternative to mitigate such effects. Indeed, the discussion is limited to the following:	The Secretary retains the authority to protect the Colorado River system if hydrologic conditions require additional action. This SEIS does not project or limit what those additional actions may be, and does not foreclose Reclamation conducting necessary additional environmental compliance. In Table E-15 of the RDSEIS Appendix E, Shortage Allocation Model Documentation, Lake Havasu City is shown bearing a maximum shortage of 638 acre-feet of consumptive use relative to its primary entitlement to divert 19,192.7 acre-feet. Protecting the operation of Hoover Dam as designed preserves the Secretary's ability to physically deliver this water to Lake Havasu City and other downstream entitlement holders.

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308	12	LOWERDIVI - Water Deliveries to Lower Division States	In addition, as previously mentioned, almost all of the fourth priority mainstream entitlement holders in Mohave County pump their water from wells. BOR accounts for this water as Colorado River water. The Revised Draft SEIS does not distinguish between fourth priority mainstream pumpers and those who physically divert water from the River. The Revised Draft SEIS simply concludes that under several of the modeled outcomes, ALL fourth priority water use is eliminated. There is no evaluation of whether the elimination of pumping has any impact on Colorado River operations or the stated goals of ensuring that Glen Canyon Dam continues to operate under its intended design for purposes of downstream water releases and to protect Hoover Dam operations, system integrity and public health and safety. The vast majority of mainstream pumping that is considered by BOR to be Colorado River water occurs below Hoover Dam. Stopping that pumping will do nothing to ensure that Glen Canyon Dam continues to operate or to protect Hoover Dam operations, system integrity, or public health and safety.	Thank you for your comment about pumping. As shown in Table E-12 of the Revised DSEIS, there is no modeled outcome under which all fourth priority water use is eliminated.
353	1	LOWERDIVI - Water Deliveries to Lower Division States	1. In this draft of the SEIS the Bureau has selected the Lower Division Proposal (LDP) as the Proposed Action. Our understanding is that much of the conserved consumptive use in the LDP is voluntary and compensated through Federal funding. Given the serious nature of the state of the system, we suggest that it may be unwise to rely on voluntary conservation measures in the LD. How will reductions be tracked and verified? What will happen if voluntary reductions at the levels proposed are not achieved? Further, we note that many of the reductions in usage are already a part of the LD's Drought Contingency Plan (DCP) and 2007 Interim Guidelines cuts. Are we proposing to pay the LD for reductions that would have been required anyway? Is there adequate additional risk reduction, given that a significant portion of the LDP reductions would have been taken regardless of the Bureau's efforts through this SEIS and Proposed Action? 2. The LDP includes a static reduction of 750 KAF in WY 2024; how will this be achieved? On what basis will the reduction be compared to contracted amounts? In other words, what will prevent the LD from proposing a higher release contract volume, and then accepting a reduction of 750 KAF, bringing the release volume to an amount near or at the level of a recent contract volume?	The reductions are not speculative. Conservation agreements have either been executed or are reasonably foreseeable. As of December 2023, Reclamation has executed contracts for approximately 1.55 million acre-feet of system conservation water, and is actively working on additional system conservation agreements to be signed in 2024 which could add approximately 800,000 acre-feet through 2026. The Lower Division States and their partners may also enter agreements to implement SEIS conservation and need to be given this flexibility. For example, the Lower Division States have targeted approximately 600,000 additional acre-feet of conserved water in 2023 that would count as SEIS conservation as described in the DSEIS. Reclamation has a strong partnership with the seven Basin States, water users, tribes, and Mexico, and we expect that to continue. This partnership has, among other things, resulted in conservation activities that have added approximately 5.1 million acre-feet to Lake Mead between 2007 and 2022. These types of agreements and partnerships have been effective and Reclamation will continue to utilize them to meet water conservation targets for the duration of the interim period. Section 2.7 of the SEIS states that SEIS conservation, or compensated system conservation, is in addition to mandatory reductions under the 2007 Interim Guidelines. Reduced releases from Hoover Dam do not count toward the 3.0 maf of SEIS conservation. However, SEIS conservation may include creation of ICS, as the Basin States agreed to analyze in this SEIS. Reclamation has always made its data and accounting available. It is the same type of accounting that has been done for decades, pursuant to the Supreme Court Decree, and the same type of accounting done since 2007. It is publicly available and transparent, and Reclamation has offered to provide technical assistance to increase understanding.

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539	5	LOWERDIVI - Water Deliveries to Lower Division States	Shared Shortages California and the Lower Basin states cannot bear the full burden of maintaining elevations in Lake Powell and Lake Mead under the emergency clause of the Proposed Action, or otherwise. The Upper Basin states, along with Mexico, need to share in shortages and make contributions to the system as part of any established near-term operations and the implementation of the emergency clause under the proposed action.	Sharing of shortages as described is outside the scope of this SEIS.
539	6	LOWERDIVI - Water Deliveries to Lower Division States	Full Consideration of Impacts Upon Further Action If mandatory, uncompensated reductions are to be made under the emergency clause of the Proposed Action, the Bureau should consider whether water users have access to other sources of water, whether water users have an opportunity to become more efficient or conserve water, and/or whether water users have historically forgone opportunities to conserve in determining what water users take reductions and in what volumes. These factors most certainly effect outcomes and the severity of impacts those reductions have on water users and, therefore, must be considered. If it becomes necessary, as part of its decision-making under the emergency clause, or as necessary in implementing any Basin States plan under the emergency clause, the Bureau must not only include this evaluation and use it to determine where mandatory, uncompensated reductions will be made but must also disclose to the public which users may receive a favorable exercise of discretion, why and with what environmental effects.	As noted in Section 2.7, Proposed Action, "Whenever Lake Mead's content is projected to be below an elevation of 1,025 feet, based on the April 24-Month Study minimum probable projection, the Lower Division States, after consultation with the Upper Division States, would have 45 calendar days to provide Reclamation with an implementation plan to protect Lake Mead from reaching an elevation of 1,000 feet. If an implementation plan is not acceptable to Reclamation, then Reclamation may take additional action to protect 1,000 feet." This SEIS does not project or limit what those additional actions may be.
539	8	LOWERDIVI - Water Deliveries to Lower Division States	Deliveries under the Compact The Upper Basin should continue to be required to meet its delivery obligations to the Lower Basin under the 1922 Colorado River Compact, ensuring that 7.5 million acre feet, along with one-half of Mexico's entitlement, is apportioned and delivered to the Lower Basin and Mexico each year. If it is found to not be possible to deliver 7.5 million acre-feet in a given year, any deficit should continue to be made up in succeeding years, consistent with the Compact's provision that the Upper Basin states will not cause the flow of the River at Lee Ferry to be depleted below an aggregate of 75 million acre-feet for any period of 10 consecutive years.	Comment noted. Operations will continue to comply with all aspects of the Law of the River, including the 1922 Colorado River Compact.
283	4	LTEMP - Long Term Experimental Management Plan	This SEIS must also assess the potential impacts of the proposed action to the goals and objectives of the Long Term Experimental and Management Plan (LTEMP) which provides the framework for adaptively managing Glen Canyon Dam operations, as well as the Colorado River Management Plan (CRMP), the complex visitor use management plan for the Colorado River corridor in Grand Canyon. Any reduction in annual release volume as well as monthly flow levels would have significant implications for both of these management plans, and for the environmental, cultural, and recreational resources that they are designed to protect.	As described in Section 2.7.2, hourly and daily releases would follow LTEMP parameters, so long as sufficient water is available from the annual release. If sufficient water is not available from the annual release to meet hourly and daily LTEMP release parameters, hourly and daily releases would follow the base operation daily and nightly minimum flows (8,000 cfs and 5,000 cfs, respectively), for as long as possible. If sufficient water is not available from the annual release to support the base operation nightly minimum flow of 5,000 cfs, hourly and daily releases would be consistent with the run of the river to match Lake Powell inflows consistent with protecting an elevation of 3,500 feet at Lake Powell. The SEIS analyzes cumulative effects of the alternatives in combination with the actions being considered in the LTEMP SEIS, and the LTEMP SEIS includes corresponding analysis of the cumulative impacts of its alternatives in combination with the actions considered in this SEIS.

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288	26	LTEMP - Long Term Experimental Management Plan	It is unclear from the Revised Draft SEIS whether LTEMP minimum flows will be met regardless of whether that causes reservoir elevations at Lake Powell to dip below 3,500 feet. The language in the Revised Draft SEIS around the competing goals of protecting Lake Powell reservoir elevation at 3,500 feet and meeting the mandates of the Grand Canyon Protection Act through the LTEMP minimum flows needs to be clarified throughout. [see examples on p.25-26 of attachment] Based on the statements above, Reclamation is clearly stating its intention to meet LTEMP minimum flows, but also provides several caveats for what it would do if "sufficient water is not available from the annual release" and mentions "releases would be consistent with the run of the river to match Lake Powell inflow" among other responses. Section I.D.2 above, identifies just one scenario where LTEMP monthly minimums would be difficult, if not impossible to meet, given the mid-year adjustment from 8.23 maf to 6.0 maf.	Reclamation updated the statement to include the underlined text in Chapter 2 to reduce confusion. "Sub-annual releases would comply with LTEMP and would not drop below LTEMP minimum flows, with the goal of keeping the Lake Powell elevation above 3,500 feet, <u>when possible</u>." For the hydrologic modeling of the Proposed action, all flows meet LTEMP minimums.
288	27	LTEMP - Long Term Experimental Management Plan	Reclamation needs to put measures in place as a part of the Final EIS and ROD to ensure that the environmental, cultural, and recreational resources downstream of Glen Canyon Dam are protected, mitigate any harm, and improve the values for which the Grand Canyon National Park and Glen Canyon National Recreation Area were established. This goes beyond just complying with the FEIS and ROD for the LTEMP sub-annual flow minimums.	The purpose of Reclamation's proposed action is to mitigate impacts from ongoing trends in the Colorado River System. There are limited resources for which mitigation might be appropriate in the case of the voluntary conservation actions considered in this SEIS. Biological mitigation measures will be identified in the Biological Opinions issued by the USFWS related to this SEIS. Both alternatives are consistent with the GCPA. This SEIS concerns annual releases through the Grand Canyon, but the implications for more particular subannual releases are described in Section 2.7.2.
288	31	LTEMP - Long Term Experimental Management Plan	Finally, all of the work in developing and implementing the LTEMP SEIS could be for not if reservoir elevations hover around minimum power pool for the last two years of the interim period. Nonnative fish passage through the dam is inevitable unless reservoir elevations are maintained at higher elevations (where the warm water these fish exist in does not encounter the penstocks) or a barrier is installed to prevent passage of nonnatives downstream. Based on the alternatives selected and analyzed and the prospect of a barrier existing, the outlook for preventing the establishment of smallmouth bass in Grand Canyon looks bleak.	Thank you for your comment.
484	9	LTEMP - Long Term Experimental Management Plan	Operations pursuant to the LTEMP dictate monthly, daily, and hourly releases from Glen Canyon Dam. The LTEMP does not impact annual operations at Glen Canyon Dam but rather is tailored to the annual release dictated by other components of the Law of the River. Importantly, the projected annual release from Glen Canyon Dam becomes the basis for the monthly LTEMP operations. The LTEMP ROD relied on modeling and analysis of minimum annual releases of 7.0 maf from Glen Canyon Dam. However, the Proposed Action Alternative in the Revised Draft SEIS considers a 6.0 maf annual release from Glen Canyon Dam. It is unclear how Reclamation intends to operate a 6.0 maf annual release "while maintaining LTEMP minimum flows" and being "consistent with the LTEMP ROD" when those flows were determined based on a minimum 7.0 maf annual release.	Section 2.7.2 explains how LTEMP sub-annual flows are still met with the 6.0 maf minimum annual release under the Proposed Action.

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548	13	LTEMP - Long Term Experimental Management Plan	2.7.2 COORDINATED RESERVOIR OPERATIONS (2-12, 2-13): DSEIS text referring to LTEMP operational goals for hourly, daily and monthly releases should include specific reference to section B.1.2 of the LTEMP ROD by inclusion of language describing operational flexibility permitted under specific conditions. This specificity is necessary to ensure that coordinated operations under LTEMP REQUIRE flexibility under certain conditions and should not be interpreted as merely "consistent with" the ROD.	Thank you for your comment. The text in this section references multiple sections of the LTEMP ROD, and therefore, the current citations adequately cover the materials across the ROD.
550	2	MEXICO - Water Deliveries to Mexico	2. The allocation of Colorado River water to Mexico is governed by the 1944 Water Treaty. To assess the potential effects of the alternatives in this SEIS, certain modeling assumptions are used that display projected water deliveries to Mexico. The Bureau should consult with Mexico regarding these modelling assumptions and their implications for water deliveries to Mexico and potential strategies to mitigate impacts of reduced deliveries.	Thank you for your comment. The commenter is correct that the 1944 Water Treaty governs allocation of Colorado River water to Mexico. Consultations with Mexico are carried out by the International Boundary and Water Commission. Water deliveries to Mexico under the 1944 Treaty and its implementing Minutes have been the subject of ongoing consultation with Mexico. The SEIS will not modify the allocation of Colorado River water to Mexico.
116	3	MITIGATION - Mitigation	the measures outlined in the final record of decision must be sufficiently certain and not rely on remote or speculative actions by third parties. Accordingly, to be considered as part of the final record of decision, proposed conservation measures should be supported by fully executed and binding contracts, not promises for future action.	The reductions are not speculative. Conservation agreements have either been executed or are reasonably foreseeable. As of December 2023, Reclamation has executed contracts for approximately 1.5 million acre-feet of system conservation, and Reclamation is actively working on four additional system conservation agreements to be signed in 2024. Reclamation is therefore confident that the remaining contracts will be executed. Lower Basin States may have their own agreements as to how to implement SEIS conservation and need to be given this flexibility. Reclamation has a strong partnership with the seven Basin States, water users, tribes, and Mexico, and we expect that to continue. This partnership has, among other things, resulted in conservation activities that have added approximately 5.1 million acre-feet to Lake Mead between 2007 and 2022. These types of agreements and partnerships have been effective and Reclamation will continue to utilize them to meet water conservation targets for the duration of the interim period.
288	33	MITIGATION - Mitigation	Reclamation needs to consider and propose mitigation measures to address potential harm to downstream environmental, cultural, and recreational resources. Reclamation did not consider or propose mitigation measures in the Revised Draft SEIS as required by NEPA. 40 C.F.R. 1508.25(b)(3). It appears Reclamation is relying on a separate and parallel process of developing modifications to Glen Canyon Dam operations under the LTEMP SEIS to mitigate the reasonably foreseeable impacts to water temperatures, nonnative fish passage, and harm to listed threatened and endangered species downstream. Further, Reclamation does not provide any mitigation measures for the possibility that HFEs will not be implemented during the remainder of the interim period due to low reservoir elevations and/or lack of the sediment trigger being reached. Without HFEs sandbars and beaches in Marble and Grand Canyons will erode causing impacts to biological, cultural, and recreational resources. Reclamation must consider and analyze what mitigation measures it could put in place to address these reasonably foreseeable impacts.	The purpose of Reclamation's proposed action is to mitigate impacts from ongoing trends in the Colorado River System. The resource areas addressed in this comment are addressed in the SEIS for the scope of the Proposed Action. The analysis showed that the Proposed Action balances risks between Lake Powell and Lake Mead better than the No Action alternative, as demonstrated in the graph on p. 2 of the Dear Reader Letter to the Revised Draft SEIS. In addition, the ability to reduce Lake Powell releases to 6.0 maf, the Secretary's ongoing reserved authority to take emergency actions, and the SEIS conservation in the Lower Basin states, show that reservoir elevations are more protected than under the No Action Alternative. Many of the resource areas raised in this comment are more affected by the sub-annual flows addressed in LTEMP. The LTEMP SEIS is currently being supplemented. The LTEMP SEIS will be publicly available prior to this Final SEIS and will outline various alternatives to Glen Canyon Dam operations to meet LTEMP objectives, including HFEs. The Proposed Action analyzed in the Final SEIS would provide more potential for elevations to increase in Powell to support HFEs compared to taking no action. As such, the Proposed Action is in and of itself a mitigation measure to current operations and trends.

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297	33	MITIGATION - Mitigation	The need to for a sediment management plan in Glen and Grand Canyon With the combination of Lake Powell's retreat and the massive amounts of sediment accumulating in Glen Canyon every year, massive sediment deltas are emerging and consistently moving in Glen Canyon, and deserved careful consideration in operational strategies under the SEIS NEPA process. These deltas are moving down through the mainstem river canyons. In the coming 20-50 years these "mud glaciers"58 will greatly affect the viability of the reservoir's storage capacity. In areas where the reservoir once was, mitigation efforts need to be taken where the sediment is damaging resources. On the San Juan River, the original river channel has been displaced causing a waterfall at Paiute Farms, which will create challenges for future rafting recreation and ecological challenges. The lack of riverine ecosystem connectivity at the falls has impacts on native fish populations. The waterfall has blocked upstream sediment from the San Juan, impacting not just the newly flowing sections of river below Lake Powell's full pool level, but even causing river sediment to back up farther upstream59. A sediment management plan should include some monitoring of the Paiute Farms waterfall and how it is impacting resources above the 3,700 elevation level.	This SEIS covers only the remainder of the interim period, through 2026. A long-term sediment management plan is outside the scope of this SEIS. We encourage you to provide comments on this issue for the Post-2026 EIS.
303	3	MITIGATION - Mitigation	Appropriate environmental mitigation and permitting must be incorporated as needed into the additional water conservation commitments. Contracts for additional Lower Basin water conservation must incorporate appropriate environmental mitigation, reviews, and permitting as needed. The DSEIS makes clear that up to 2.083 million acre feet (maf) of Lower Basin water delivery shortages and water conservation volumes contemplated fall within the environmental analyses for 2007 Interim Guidelines Final EIS. It further clarifies the potential for additional reductions in Lower Basin water deliveries to reach up to 3.0 maf in total water conservation by 2026 will require further environmental analyses. What remains unclear, however, is whether and to what extent environmental mitigation, review, and permitting will be completed to advance the Lower Basin's water conservation commitments that make the adjusted operations in the DSEIS achievable. In other words, the analysis of environmental impacts and suitable mitigation of actions contemplated to accomplish adjusted operations cannot be overlooked in the name of expediency.	Reclamation continues to comply with all necessary environmental compliance obligations for resulting federal actions. We have undertaken appropriate NEPA compliance for individual agreements. In addition, the BA for this SEIS currently contemplates up to 2.5 maf of reductions annually with appropriate mitigation.

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303	4	MITIGATION - Mitigation	The scale of proposed water delivery reductions suggest the need for environmental mitigation and stewardship efforts to be employed in every day actions for managing the basin. Reductions in water supply releases and deliveries without actions to accommodate the environmental resources affected could otherwise exacerbate impacts for communities, economies, and ecosystems in the region. For these reasons, we appreciate recent efforts and strongly urge future commitment of available funds from the Bipartisan Infrastructure Law, Inflation Reduction Act, or other appropriations to improve the fundamental integrity of the system going forward. Near-term priorities include: a. Endangered Species Act Compliance and Lower Colorado River Multi-Species Conservation Plan maintenance b. Grand Canyon resource maintenance (i.e., considerations for minimum annual, monthly, daily and hourly flows, risks of invasive species, consequences of changing temperature, High Flow Experiments and/or other experimental flows, etc.) c. Salton Sea mitigation. d. Adaptation and resilience building for natural resources that help sustain people and nature within the basin - i.e., soil, groundwater, water quality (including salinity), air quality resources e. Agricultural efficiency improvements with water savings providing co-benefits to the system.	Thank you for your comment.
310	9	MITIGATION - Mitigation	It appears that Reclamation proposes no mitigation for any of the myriad effects on nature and human activities envisioned in both alternatives. Mitigation needs to be simultaneous with the actions proposed in the RDSEIS. Mitigation delayed is too often mitigation denied.	The purpose of Reclamation's proposed action is to mitigate impacts from ongoing trends in the Colorado River System. There are limited resources for which mitigation might be appropriate in the case of the voluntary conservation actions considered in this SEIS. Biological mitigation measures will be identified in the Biological Opinions issued by the USFWS related to this SEIS.
310	16	MITIGATION - Mitigation	The RDSEIS recognizes adverse effects in environmental justice, socioeconomics, and Indian Trust Assets, but no mitigation is proposed. Is Reclamation claiming that the effects on these communities are insignificant? Or rather that the predicted effects won't happen so that no mitigation is required? We fail to understand why Reclamation does not include a plan for the mitigation of these effects.	The purpose of Reclamation's proposed action is to mitigate impacts from ongoing trends in the Colorado River System. Continuing with current operations through 2026 would likely result in adverse effects on environmental justice communities, socioeconomics, and Indian Trust Assets. There are limited resources for which mitigation might be appropriate in the case of the voluntary conservation actions considered in this SEIS. Entities wishing to participate in conservation under the Proposed Action do so voluntarily and are compensated for their participation.
310	26	MITIGATION - Mitigation	In any reasonably foreseeable future, the likelihood of hitting power pool elevations and even lower will only increase. Reclamation needs to be making plans for replacing both the hydropower and important revenues generated at the Glen Canyon Dam. The revenues generated are important sources of funding for several significant environmental programs, such as the Endangered Species Recovery Programs in the Upper Basin. Plans must be in place for the financial maintenance and continuation of these programs should the day come when hydropower generation no longer proves a reliable source of funds.	Thank you for your comment. Reclamation is exploring options to address these issues. However, the suggested action is outside the scope of this SEIS.

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353	2	MITIGATION - Mitigation	3. The LDP represents roughly half of the reductions originally put forward in Action Alternatives from the first Draft SEIS. Recognizing the hydrological improvements from the winter of 2022/2023, it is overly optimistic to allow significantly smaller reductions based on a single year of positive hydrology. Records indicate that only 6 of the past 24 years have produced at or above-average precipitation in the Colorado River Basin. Prevailing science indicates that a more conservative approach is needed. 4. With respect to the cuts proposed in the LDP, in addition to the operational and accounting issues cited previously, implications of this much smaller reduction may include reinforcing the already-entrenched mindset of overuse in the Lower Division. The impact on the post-2026 operational guidelines may also be substantial.	It is Reclamation's view that the Proposed Action, as demonstrated in the Dear Reader Letter to the Revised Draft SEIS (p.2), balances risks between Lake Powell and Lake Mead better than the operational tiers considered in Action Alternatives 1 and 2 through 2026. The hydrologic modeling examines scenarios based on flows in the Basin over the past 30 years, which includes the driest 23-year period on record. To examine even worse drought conditions, the hydrologic modeling examines Basin flow scenarios with 90 percent and 80 percent of the flows seen over the past 30 years (up to a 20 percent reduction in flows compared with the last 30 years).
548	4	MITIGATION - Mitigation	2.5 COMMON TO ALL ALTERNATIVES (2-3): Reference is made to PL 117-169 Section 50233, part of the "4 billion dollars for drought mitigation". These funds should be considered for use in mitigating impacts to the hydropower purpose which are a direct or indirect result of this DSEIS or the concurrently proceeding LTEMP SEIS, as these are connected activities. It is CREDA's understanding that to date, none of the $4 billion has been allocated or used for hydropower purposes. CREDA recognizes that implementation of these efforts is ongoing and urges Reclamation to consider this funding for broader mitigation of direct and indirect impacts of this DSEIS and the LTEMP SEIS.	Distribution of these funds is outside the scope of the SEIS.
9	1	MODEL - Modeling	The RDSEIS states that USBR has a set of Excel worksheets that “simulate shortages.” See E-2. Are those available to the public?	Yes, the Shortage Allocation Model worksheets are available to the public; please email CRInterimops@usbr.gov.
12	1	MODEL - Modeling	My colleague Ben Horwich (cc'd) and I represent four Yuma-area irrigation districts (Yuma Mesa Irrigation and Drainage District, Wellton-Mohawk Irrigation and Drainage District, North Gila Valley Irrigation and Drainage District, and Yuma Irrigation District) in Colorado River administrative proceedings. We are reviewing your recently released Revised Draft Supplemental Environmental Impact Statement (“RDSEIS”) for Near-term Colorado River Operations to analyze its impact on our clients. The RDSEIS states that USBR has a set of Excel worksheets that “simulate shortages.” See E-2. Are those available to the public?	Yes, the Shortage Allocation Model worksheets are available to the public; please email CRInterimops@usbr.gov.

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115	7	MODEL - Modeling	Based on Reservoir operational conditions and using 2002-2005 hydrology, the Lake Powell elevation was below 3490 feet, the minimum power pool elevation from the end of April 2023 to the end of the study period, with the end of September 2024 having the lowest vertical deficit of 65 feet below minimum power pool at about the end of April 2024. Even though recent analyses have shown some improvement, this general scenario is expected to cause exceptionally serious extended electrical outage causing human suffering and economic hardship to the region's population and businesses, especially in areas like Indian reservations that are already under economic distress. We believe it is of great importance for our Tribe, other Tribes, and stakeholders in the region to gain a fairly good understanding of the magnitude of the ensuing prolonged drought resulting in diminishing river flows and the likelihood (probability) that similar hydrology like that of 2002-2003 would be expected to take place in 2023-2024. Providing an estimate of the risk that the 2002-2003 hydrology will take place in 2023-2024 is essential for the Colorado River Basin for our Tribe and others in order to gain and appreciate the ensuing magnitude of the problem and, thus, the comments of our Tribe will be based on more realistic information. Likewise, where Lake Mead elevations are concerned, based on the present reservoir operations and using 2002-2003 hydrology in place of 2023-2024 hydrology, minimum Lake Mead Pool Elevation (950 feet) is far from being impacted by the lowest hydrology on record, which is good news. In fact, the lowest vertical elevation is about 45 feet higher than the minimum power pool occurring about the end of September 2024. The bad news is that level 3 shortage conditions are expected to take place starting at about the end of June 2023 until the end of September 2024, and the trend continues to worsen beyond September 2024 (without consideration of conservation efforts). Again, it is imperative for our Tribe and other stakeholders in general to be informed of the probability that the 2023-2024 hydrology would be similar to that of the 2002-2003 hydrology. The comments by stakeholders are expected to be from a position of being relatively more informed as to the risks involved and the resulting comments will be reflective of the depth and magnitude of the projected problem. We also believe that it would be more informative for our Tribe, and other tribes and stakeholders, to gain a fairly good understanding that the 80% Ensemble Streamflow Prediction (ESP) hydrology of 2002-2005 Traces would likely occur with an estimated probability in 2023-2026. It is, therefore, important that our Tribe and other stakeholders gain an understanding based on the probability of the risks with which a 2002-2005 hydrological condition will occur in 2023-2026. [See comment letter for additional details.]	The future is highly uncertain; hydrology is the main source of uncertainty but there are other sources. The SEIS showed that under a very wide range of probable hydrologies, the Proposed Action reduced the risk of falling under critical elevations at Powell and Mead. Reclamation continues to offer ongoing consultation and informational meetings to Basin tribes and other stakeholders through this and the Post-2026 process. We would be happy to meet with the Ute Tribe to discuss in more detail.

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294	9	MODEL - Modeling	b. Additionally, the hydrology within the Colorado River Basin is highly uncertain. The Colorado River Basin remains one bad year away from a catastrophic failure of water supply that could have unacceptable consequences for the Colorado River, and the millions of people who depend upon the River's supply. The hydrology scenarios used in the Revised SEIS are derived from the June 2023 Ensemble Streamflow Prediction (ESP) Upper Basin forecast. Three sets of the ESP were used that include 100% ESP, 90% ESP and 80% ESP. The hydrology used to evaluate Alternatives 1 and 2 and the proposed action does not adequately consider low flow conditions and as a result the risk of Powell dropping below 3,500 ft is consequently understated. Recent history shows that contents at Powell dropped to a low of 5.375 million ac-ft in March 2023 despite reducing releases in 2022 to 7.0 million ac-ft and releasing close to half a million ac-ft from the Colorado River Storage Project (CRSP) Act reservoirs to bolster contents at Powell. Contents at Powell were 8.8 MAF just two years prior to that in March 2021, which corresponds with near-current contents at Powell at the end of October 2023. While Reclamation's percent of traces reaching critical elevations at Lake Powell for Alternatives 1 and 2 decreased from 9 percent to 0 percent using the updated June 2023 forecast, and from 44 percent to 10 percent for Mead, as of the end of October 2023, both reservoirs remain at such low levels (3,572.71 ft for Powell and 1064.81 ft for Mead) that there is little buffer to sustain a single bad year. This demonstrates that under the 2007 Interim Guidelines, Lake Powell contents could similarly drop to levels close to 3,500 ft in less than two years if the hydrology is similar to the most recent period.	Between the revised draft and final documents, Reclamation reviewed the current hydrology to determine if it warranted changes to the analysis. Based on this review, Reclamation determined that the hydrology used in the revised Draft SEIS analyzed a range of hydrology for June 2023 – September 2024 even drier than the current forecast. Additionally, since the analyses are not intended to suggest actual probabilities but rather compare performance across alternatives, and because it is intended to analyze operational strategies across a wide range of low-flow hydrologic scenarios, the hydrology used in the revised Draft SEIS is sufficient and did not warrant any revisions. The hydrologic modeling examines scenarios based on flows in the Basin over the past 30 years (not the 30-year average), which includes the driest 23-year period on record. To examine even worse drought conditions, the hydrologic modeling examines Basin flow scenarios with 90 percent and 80 percent of the flows seen over the past 30 years (up to a 20 percent reduction in flows compared with the last 30 years). As the commenters mentioned, the No Action Alternative does show a possibility of Powell declining below 3,490' as early as 2025, even when using the June hydrology. The Proposed Action reduces the risk of Lake Powell falling to 3,490' in 2025 and 2026.
297	3	MODEL - Modeling	Despite a good water year, the SEIS should have modeled for drier conditions. [...] The SEIS used modeling assumptions based on the "improved hydrology" of water year 2023, and forecasts a low probability of Lake Powell and Mead dropping to critical levels through 2026, stating, "Regarding Lake Powell, under the Lower Division Proposal, 4 percent of traces show Lake Powell reaching critical levels through 2026, which is an improvement over the 8 percent of traces under the No Action Alternative." While 4% and 8% traces are indeed low, they are not zero. And Reclamation has a history of being overly optimistic when it comes to hydrologic forecasting. While it is statistically unlikely, it is within the realm of possibility that reservoirs drop to critical levels in 2026.	The hydrologic modeling examines scenarios based on flows in the Basin over the past 30 years, which includes the driest 23-year period on record. To examine even worse drought conditions, the hydrologic modeling examines Basin flow scenarios with 90 percent and 80 percent of the flows seen over the past 30 years (up to a 20 percent reduction in flows compared with the last 30 years). We acknowledge there is a possibility for reaching critical levels. Through the SEIS we are proposing operational changes to protect critical elevations.

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297	4	MODEL - Modeling	The hydrologic reality of the Colorado River, and the need to forecast for even lower flows. The impacts being experienced in the Colorado River are unlike anything that's been seen in this millennium, which is one of the reasons current modeling used by Reclamation, the Colorado River Mid-term Modeling System (CRMMS), informed by Colorado River Forecast Center, has proven to be overly optimistic for most of the past decade. A 2021 white paper by The Futures of the Colorado Group evaluated Colorado River projections used by the Bureau and found that the agency has consistently underestimated the impacts of climate change and overestimated the amount of water projected to flow in the Colorado River, specifically into Lake Powell. White Paper #79 states that, Reclamation's 24-month studies have consistently overestimated runoff of the studies' 2nd year "most probable" projection. The study found that the Bureau's "most probable projected inflows were higher than what actually occurred by as much as ~7 million acre feet (maf) in some years, and predicted reservoir elevations were also higher than what occurred in some years."	The hydrologic modeling examines scenarios based on flows in the Basin over the past 30 years, which includes the driest 23-year period on record. To examine even worse drought conditions, the hydrologic modeling examines Basin flow scenarios with 90 percent and 80 percent of the flows seen over the past 30 years (up to a 20 percent reduction in flows compared with the last 30 years).
301	3	MODEL - Modeling	Although the proposed alternative in the SEIS does not rely on the Shortage Allocation Model to distribute shortages among water users in Nevada, the CRCNV does not agree with some of the models' assumptions or the interpretation of Nevada's entitlement dates in allocating shortages.	We look forward to discussing your feedback further during the Post-2026 process.
302	8	MODEL - Modeling	With this revised draft SEIS analysis, we have less confidence in Reclamation's modeling procedures because it appears that Reclamation has cherry-picked the assumptions and parameters to reach its preferred outcome rather than rigorously undertaking a scientifically sound approach that does not aim at a predetermined outcome.	Reclamation worked with the lower basin states for assumptions based on the states proposal for the proposed action. The analysis performed in the revised draft follow Reclamations standard procedures. The only procedure that differed from Reclamation's standards was the creation of 80% and 90% traces which were used to analyze drier conditions than the 30-year record.
310	2	MODEL - Modeling	One of the things that Reclamation should not do in selecting a Preferred Alternative is engage in creative water accounting. The water levels of Lake Powell and Lake Mead must reflect their measured levels rather than paper water levels. In 2022, Reclamation released 980,000 acre-feet (af) from reservoirs upstream of Lake Powell. 480,000 af of this water remained in Lake Powell, but the level of Lake Mead was adjusted on paper as if Lake Mead had received the 480,000 af . This very likely kept the level of Lake Mead from falling into a Level 2b cutback under the Drought Contingency Plan, potentially delaying further water use reductions by Arizona and Nevada and not forcing California to take a 200,000 af reduction for the first time since the Drought Contingency Plan was adopted (Allhands 2022). The discrepancy between the paper level of water in Lake Mead and its true, measurable level must be reconciled immediately in order to recover Reclamation's credibility about how water releases and reservoir levels will actually be accounted for under the RDSEIS's alternatives.	Changing Lake Powell and Lake Mead's operating tier is outside of the scope of this SEIS. Additional information on Lake Powell and Lake Mead's operating tiers for 2024 is provided in the August 2023 24-month study.
310	17	MODEL - Modeling	As requested in our scoping comments, Colorado River management and decision-making should be informed by (1) an ensemble of vetted physico-hydrological-ecological models from both government and academia; (2) both current weather/climate conditions as well as climate change scenarios driven by CO2, and (3) Native American cultural knowledge. Such models should be fed by real water and not paper water, and the assumptions of models should be tested and appropriately parameterized. By these criteria, the RDSEIS falls short.	Our analysis relies on a forecast based on past climate (1991-2020) and we reduced those forecasts to generate lower flows. The 30-year record is standard across NOAA. Climate change analysis will be more appropriate for the post-2026 analysis. This analysis only covers the remainder of the interim period, through 2026. Focusing on lower flow conditions explores a range of conditions outside of the past 30-years of climate. Tribal consultation is ongoing to address Tribal impacts and incorporate traditional knowledge into the SEIS as it becomes available.

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310	22	MODEL - Modeling	Equalization and Upper Elevation Balancing Tier flows must occur only when sediment conditions are adequate to prevent beach and sandbar erosion in the Grand Canyon. Equalization and Upper Elevation Balancing Tier flows are common to both alternatives despite the fact that research reveals that they have significantly eroded Grand Canyon's beaches and sandbars in the past (RDSEIS section 2.7.2, p. 2-10, Ashley et al. 2020, Fig. 8; Grams et al. 2018, Fig. 2; Jacobs, McCoy, and Martin 2019, 25). Previous implementation of the 2007 Interim Guidelines via equalization flows between the reservoirs in 2011 caused irreparable damage to the Grand Canyon by scouring sediment from beaches and sandbars that will never be fully replaced. The RDSEIS must analyze the impacts of all flows authorized in all actions in the RDSEIS on sediment retention in the Grand Canyon. By only analyzing the impacts of HFEs as authorized under the Long-Term Experimental and Management Plan (LTEMP) (RDSEIS section 3.5.1, p. 3-11), Reclamation is ignoring a known and demonstrated harm that it will cause to the Grand Canyon with this RDSEIS. HFE implementation is only one component of the Grand Canyon's sediment balance. Reclamation must time Equalization and Upper Elevation Balancing Tier flows to occur when sediment conditions are adequate and should use existing science to determine the proper timing and best flow pattern to release these elevated flow levels while also conserving the Grand Canyon's sediment balance. We are glad to see that Reclamation intends to meet the distributions and experimental flow patterns of LTEMP, but Reclamation must modify the Equalization and Upper Elevation Balancing Tier flows to protect sediment, temperature, water quality, and other ecological requirements of the Colorado River ecosystem in the Grand Canyon. It is not enough to conduct an HFE for a short amount of time and then allow an Equalization or Upper Elevation Balancing Tier flow to erode beaches and sandbars for weeks or months at a time. Reclamation must structure Glen Canyon Dam's annual, monthly, and daily flow patterns to protect the Grand Canyon. Recommendation 2: The model predictions for river operation should be based on realistic future flow estimates. As the residence time of water behind the dam is of the order of 2-3 years, basing predictions and impacts based on 30-year average flow (or 80%-90% of the 30-year average flow) is unrealistic and can lead to further worsening of water levels, especially as climate change is expected to continues to strengthen in the future.	The purpose of and need for the SEIS is to address low reservoir/low flow conditions and not to revisit high flow conditions. This effort is a supplement to annual releases to specify conditions for lower Glen Canyon releases based on declining reservoir levels. No other changes to the annual release under the Guidelines are proposed beyond what was analyzed in the 2007 Interim Guidelines EIS. Equalization and balancing flows are annual flow issues currently determined by the Guidelines. Such releases may have effects on sediment resources in the Grand Canyon. We encourage comment in the EIS process associated with LTEMP, which will address, among other things, resource conditions in the Grand Canyon, including for fish species and sediment. The hydrologic modeling examines scenarios based on flows in the Basin over the past 30 years (not the 30-year average), which includes the driest 23-year period on record. To examine even worse drought conditions, the hydrologic modeling examines Basin flow scenarios with 90 percent and 80 percent of the flows seen over the past 30 years (up to a 20 percent reduction in flows compared with the last 30 years). The improved hydrology from June 2023 described in the Dear Reader Letter to the Revised Draft SEIS does not indicate a risk of operating Glen Canyon and Hoover Dams in a situation where the inflow minus losses equals outflow, subject to run-of-the-river conditions during the remainder of the interim period, through 2026. Reclamation believes the range of hydrology scenarios analyzed is an appropriate worst case to analyze for conditions that might occur between now and 2026.
322	2	MODEL - Modeling	Under the DSEIS, a mid-year adjustment to Glen Canyon Dam is permissible if the minimum probable scenario in the 24-Month Study shows Lake Powell dropping below 3,500 feet at any point in the following 12 months. It is unclear how a mid-year adjustment can be made when the trigger is a minimum probable scenario under "any" 24 Month Study. The FSEIS should elaborate on any other actions that might be taken under existing Upper Basin Drought Response Operations Agreement (DROA) prior to reducing releases from Glen Canyon Dam. Moreover, reduced releases from Glen Canyon Dam may drive Lake Mead to low elevations that would require the United States to consult with the Basin States on measures to protect critical elevations. See Revised Draft SEIS at 2-8.	Any potential future DROA releases will be implemented through the process defined under the Upper Basin DCP's Drought Response Operations Agreement. In the RDSEIS modeling, there were no assumed future DROA releases, though a sensitivity analysis for potential DROA contributions was provided in Appendix F.

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326	10	MODEL - Modeling	[Dear Reader Letter, page 0-1] In Dear Reader letter, first paragraph, explain what you mean by "improved hydrology." It's not clear whether this means improved hydrological modeling, or whether hydrological conditions improved on the ground. Please explain what specific elements of the hydrology improved (for example, increase in stage, increase in flows during a critical period, favorable changes in the timing and duration of flows, etc.). This will help readers understand why the two model runs (Sep 2022 and June 2023) yielded such different results, along with the uncertainty and associated limitations of the forecasts. Helping readers understand the change in forecasting is especially important since the June 2023 forecast was the basis for eliminating Alternatives 1 and 2 from detailed analysis. Not all readers will have a hydrologic background, an explanation in plain language for clear government communication that the public can understand and use would be appreciated.	The latest draft of the SEIS included updated hydrologic conditions from June 2023, representing the most recent data available, in which reservoir levels in Powell had increased from those in September 2022.
326	62	MODEL - Modeling	[Section Appendix B, page B-27] Please provide a summary that compares these modeled shortages for each year. The first paragraph needs additional information.	This analysis is included in Chapter 3 of the SEIS (e.g., Figure 3-21).
326	64	MODEL - Modeling	[Section D.3.3, line 18, page D-7] What circumstances could produce a negative forecast? An explanation would help our understanding of the equation.	Updated sentence to: "The hydrologic inputs for the Lower Basin are intervening flows (Table D-4), which may be positive, representing a gain in the reach (e.g., local inflows), or negative, representing a loss in the reach (e.g., losses to ground water, evapotranspiration, or other processes)."
326	65	MODEL - Modeling	[Section D.5.7, lines 19-20, page D-10] Please provide detail for the reason to choose no DROA releases in the hydrologic modeling. The Appendix F comparison between no DROA and DROA contributions indicates that the choice affects the shortage tier and DCP contributions in 2026. (page F-8)	Whether DROA releases would occur or what volume of DROA releases could occur cannot be known until there is an assessment of the hydrologic conditions at the time of DROA triggers. The hydrologic model evaluates potential DROA releases through a sensitivity analysis, which provides the best information about a potential DROA release for the remainder of the interim period, through 2026.
370	4	MODEL - Modeling	Because of this reliance, the Reclamation report is neither scientific nor objective in the following ways: a) to estimate future Colorado water flows it relies on the model used by Tetra Tech, a consulting firm used by the Salton Sea Management Plan to develop the various "in basin" restoration plans. Tetra Tech's model is based on the Salton Sea Accounting Model which was developed 20 years ago by Reclamation, before the QSA and the drought. This model has been altered by Tetra Tech for use with the Salton Sea Management Plan. Criminally, Tetra Tech has concealed it's methods so it can't be evaluated by independent experts. During the meetings of the Long Range Planning Committee in 2023, several members raised objections to the role played by Tetra Tech because it was a conflict of interest since they wanted to be given contracts to complete some of the proposed projects. James Newcomb, chair of the committee, refused to discuss these objections. Tetra Tech's integrity has also been questioned because it has been sued by the Department of the Navy because it falsified soil samples in the Hunter's Point area in 2019. b) the report fails to present remedies in case their modeling of water supplies are too high. c) the discussion of impacts of the proposed cuts in water supply to the Salton Sea are inadequate and unreasonable. d) the report relies on insufficient, speculative and ineffective mitigation measures.	Analysis for the Salton Sea as it pertains to the proposed action and alternatives is addressed. As noted in section 3.5.2, additional details are addressed in the US Army Corps of Engineers Environmental Assessment for the implementation of the 10-Year Plan projects for the Salton Sea (US Army Corps of Engineers 2022). The SSAM model represents the best available tool to evaluate inflow impacts to Salton Sea surface water elevation and uses widely accepted hydrological modeling practices. Although the California Natural Resource Agency (CNRA) does not post the SSAM model online, it is available to the public, scientific professionals, and partner agencies upon request. CNRA, US Army Corps, US Geologic Service, Reclamation and other partner agencies will evaluate the tool and update its parameters as necessary to support the ongoing Imperial Streams, Salton Sea, and Tributaries Feasibility Study.

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Form Letter 1	2	MODEL - Modeling	The lower basin states is a good alternative and compromise for low water years until the post 2026 guidelines can be completed. I do believe this plan could be improved if BOR used more than a 24 month analysis to predict water levels for the balancing tiers and releases. Because we had a great water year in 2022-2023, this does not mean Lake Powell and Lake Mead aren't still at critical levels. BRC recommends a 5 year analysis. Hydrology reports also are from September 2022 and June 2023. BOR should be using a 5 year average for hydrology analyses. Using best available science is crucial for NEPA and using a longer study will give more accurate data points.	The scope of the SEIS is only through the IG period which expires in 2026. The Post-2026 process will inform the period after 2026. The 1991-2020 climate are used to create 30 unique forecasts, each covering the length of the analysis period (3.5 years, June 2023-December 2026). Each of these 30 traces was then reduced to 80% and 90% of projected streamflow resulting in a total of 90 unique streamflow sequences. Focusing on lower flow conditions explores a range of conditions outside of the past 30-years of climate.
288	1	NEPAGEN - NEPA Process	The Revised Draft SEIS does not meet the minimum requirements of the National Environmental Policy Act ("NEPA"). Reclamation's analysis of only two alternatives and its premature choice to eliminate all but one action alternative from the analysis also significantly limits the ability of the basin sovereigns, stakeholders, and the public from being privy and able to understand and provide feedback on the choices before the agency. Over the past year, Reclamation received proposals from the 6-Basin States (Arizona, Colorado, Nevada, New Mexico, Utah, and Wyoming)9, California10, and the Lower Basin States11 among others offering demand reductions, policy revisions, and other ideas for sustaining the Colorado River system. In addition, Reclamation spent many months and resources to develop two of its own alternatives that were completely analyzed in the April 2023 Draft SEIS for near-term operations. Yet, Reclamation eliminated nearly all these alternatives from the Revised Draft SEIS and chose to move forward with only the Lower Basin's proposal and the No Action Alternative. Reclamation's failure in this regard undermines not only the alternatives analysis but the entirety of the NEPA process limiting the dialogue around possible short- and long-term policy changes that is so desperately need in the basin.	The range of alternatives analyzed in this SEIS is reasonable. Action Alternatives 1 and 2 were considered in the original Draft SEIS but were ultimately dismissed from detailed analysis in the revised Draft SEIS because their performance was similar to or worse than the Lower Division proposal (now the Proposed Action) as explained in the Dear Reader Letter and Section 2.8. As explained in the Dear Reader Letter to the revised Draft SEIS, Reclamation analyzed the Lower Division Proposal (now the Proposed Action) at the request of the Seven Basin States, and that analysis shows that the Proposed Action balances the risk between Lake Mead and Lake Powell better than the alternatives considered in the Original Draft SEIS. The current range of alternatives thus meets the purpose and need to address low reservoir conditions across the Basin in the short term and, perhaps more importantly, provides the space "so that all parties can focus their resources on the development of the post-2026 guidelines" as described by the Seven Basin States. Reclamation modeled these proposals in Appendix B of the Original Draft SEIS. These proposals were similar to the actions considered in Action Alternatives 1 and 2 in the original Draft SEIS and are similarly affected by the improved June 2023 hydrology. Reclamation is not remodeling these proposals or comparing them against the Proposed Action for the same reasons that Action Alternatives 1 and 2 have been eliminated (see the Dear Reader Letter and Section 2.8.10).
288	12	NEPAGEN - NEPA Process	The current range of alternatives analyzed by Reclamation related to Section 2. Shortage Conditions at Lake Mead does not constitute a reasonable range as required by NEPA. Reclamation should have carried through and fully analyzed at least one, if not more, of the state's proposals and/or its own Alternatives 1 and 2 with the selected alternatives in the Revised Draft SEIS. Reclamation missed a critical opportunity to model and share the impact of greater demand reductions on reservoir elevations and how that could impact or mitigate the environmental effects to important resources.	The range of alternatives analyzed in this SEIS is reasonable. Action Alternatives 1 and 2 were considered in the original Draft SEIS but were ultimately dismissed from detailed analysis in the revised Draft SEIS because their performance was similar to or worse than the Lower Division proposal (now the Proposed Action) as explained in the Dear Reader Letter to the Revised Draft SEIS and Section 2.8. Reclamation analyzed the Lower Division Proposal (now the Proposed Action) at the request of the Seven Basin States. The current range of alternatives thus meets the purpose and need to address low reservoir conditions across the Basin in the short term and, perhaps more importantly, provides the space "so that all parties can focus their resources on the development of the post-2026 guidelines" as described by the Seven Basin States. Reclamation modeled these proposals in Appendix B of the Original Draft SEIS. These proposals were similar to the actions considered in Action Alternatives 1 and 2 in the original Draft SEIS and are similarly affected by the improved June 2023 hydrology. Reclamation is not remodeling these proposals or comparing them against the Proposed Action for the same reasons that Action Alternatives 1 and 2 have been eliminated (see the Dear Reader Letter and Section 2.8.10).

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288	18	NEPAGEN - NEPA Process	The Trust is very curious what the outcome of certain of these policies may be including how the 6.0 maf Glen Canyon Dam release reduction is implemented and what impact to reservoir elevations at Lakes Powell and Mead occur if the protection level at Lake Powell is raised from 3,500 feet (only 10 feet above minimum power pool) to 3,525 feet or even 3,515 feet based on the reality that the closer Lake Powell elevations are to the penstocks the warmer penstock releases and the more likely non native fish will pass through the dam. Unfortunately, due to the narrow purpose and need, limited range of alternatives analyzed in the Revised Draft SEIS, and the failure to move all but the no action and proposed action through a complete effects analysis these questions and many others remain unanswered. Under NEPA, Reclamation is required to "[r]igorously explore and objectively evaluate all reasonable alternatives" in response to a "specif[ied] purpose and need."Reclamation's failure to do that here when it chose to consider but ultimately eliminate Alternatives 1 and 2, the 6-State Plan, and the California Plan. This decision renders its NEPA analysis incomplete and not meet the "hard look" required by NEPA.	The range of alternatives analyzed in this SEIS is reasonable. Action Alternatives 1 and 2 were considered in the original Draft SEIS but were ultimately dismissed from detailed analysis in the revised Draft SEIS because their performance was similar to or worse than the Lower Division proposal (now the Proposed Action) as explained in the Dear Reader Letter to the Revised Draft SEIS and Section 2.8. Reclamation analyzed the Lower Division Proposal (now the Proposed Action) at the request of the Seven Basin States. The current range of alternatives thus meets the purpose and need to address low reservoir conditions across the Basin in the short term and, perhaps more importantly, provides the space “so that all parties can focus their resources on the development of the post-2026 guidelines” as described by the Seven Basin States. In addition, the ability to reduce Lake Powell releases to 6.0 maf, the Secretary's ongoing reserved authority to take emergency actions, and the SEIS conservation in the Lower Basin states, show that the system is more protected than under the No Action Alternative. The purpose and need is sufficient to meet the low-runoff conditions in the basin until the Post-2026 process is complete. We encourage you to submit comments on additional operational strategies as part of the Post-2026 process.
303	11	NEPAGEN - NEPA Process	While critical to the stability of the basin, the NEPA process for adjusting or developing new interim guidelines is not the sole solution to the challenges confronting the basin - parallel, resilience-building processes will still be needed. The Interim Guidelines need not and cannot be the silver bullet answer to mitigating risk in the Colorado River Basin. Its scope and focus are limited to managing the declining water supplies available to the Basin. Long-term focus and investment in reliable water management and resilience building strategies that work with but outside of the Interim Guidelines process will also be needed to adapt and build resilience to an increasingly dry and variable system in all corners of the Basin.	Thank you for your comment.
308	2	NEPAGEN - NEPA Process	With regard to the Lower Division Proposal, this becomes the basis for the single Proposed Action considered by BOR along with the No Action Alternative. To only consider only one alternative related to such a significant federal action is irregular; BOR even acknowledges that such" a single action alternative is not preferred in NEPA analysis." Revised Draft SEIS at Dear Reader Letter. Moreover, the reality is that neither the No Action Alternative nor the Proposed Action is a viable alternative because neither substantially meets BOR' s stated Purpose and Need for this project. So, in effect, no reasonable alternatives have been considered.	The range of alternatives analyzed in this SEIS is reasonable. Action Alternatives 1 and 2 were considered in the original Draft SEIS but were ultimately dismissed from detailed analysis in the revised Draft SEIS because their performance was similar to or worse than the Lower Division proposal (now the Proposed Action) as explained in the Dear Reader Letter to the Revised Draft SEIS and Section 2.8. Reclamation analyzed the Lower Division Proposal (now the Proposed Action) at the request of the Seven Basin States, and that analysis shows that the Proposed Action balances the risk between Lake Mead and Lake Powell better than the alternatives considered in the Original Draft SEIS. The current range of alternatives thus meets the purpose and need to address low reservoir conditions across the Basin in the short term and, perhaps more importantly, provides the space “so that all parties can focus their resources on the development of the post-2026 guidelines” as described by the Seven Basin States.

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308	15	NEPAGEN - NEPA Process	Draft Revised SEIS at pp. 3- 284-- 3- 285 (emphasis added). As discussed below, the Proposed Action leaves any mitigation to be developed in an emergency 45- day consultation period. In that regard, BOR has failed to objectively evaluate all reasonable alternatives, as it is required to, because it appears to have not evaluated any alternatives that substantially meet BOR' s stated Purpose and Need for this project. Moreover, NEPA requires agencies to" take a hard look at environmental consequences" of their proposed actions, consider alternatives, and publicly disseminate such information before taking final action. Robertson v. Methow Valley Citizens Council, 490 U. S. 332, 350 (1989) emphasis added). Based on the Revised Draft SEIS, BOR has failed to take such a" hard look" because the single action alternative BOR has considered fails to identify and consider the public health and safety issues that will arise for entitlement holders for whom the Colorado River is the sole source of water available to them. 3 This is a major concern for the Arizona fourth priority mainstream entitlement holders within Mohave County: this is the only source of water available for these communities. No other surface water supplies exist, and groundwater supplies are highly limited. Almost all of the fourth priority mainstream entitlement holders in Mohave County are pumping water from wells that BOR has unilaterally categorized as pumping mainstream Colorado River water. Groundwater is physically limited to the mainstream entitlement holders. Groundwater cannot be imported. A. R. S. SS45- 544,(precluding the transportation of groundwater from other Arizona groundwater basins to the mainstream basin(s)). And the limited supplies of effluent have very limited resiliency, and are often accounted for as part of a River entitlement. BOR' s mere statement that these on-river communities, which rely solely on Colorado River Water for their existence, may " potentially [be] affected by the proposed alternatives" is hardly the hard look that NEPA requires. Draft Revised SEIS at p. 3- 284.	The DSEIS notes that intensive efforts are underway to facilitate water conservation actions in the Basin under a number of programs, including the recent congressional prioritization of funding through the Inflation Reduction Act of 4 billion dollars for drought mitigation in western states, with priority given to the Colorado River Basin and other basins experiencing comparable levels of long-term drought (Public Law 117-169 at Section 50233, August 16, 2022). The ongoing implementation of these efforts will help determine the degree to which revised operations will be implemented. The Secretary retains the authority to protect the Colorado River system if hydrologic conditions require additional action. This SEIS does not project or limit what those additional actions may be, and does not foreclose Reclamation conducting necessary additional environmental compliance. In Table E-15 of the RDSEIS Appendix E, Shortage Allocation Model Documentation, Lake Havasu City is shown bearing a maximum shortage of 638 acre-feet of consumptive use relative to its primary entitlement to divert 19,192.7 acre-feet. Protecting the operation of Hoover Dam as designed preserves the Secretary's ability to physically deliver this water to Lake Havasu City and other downstream entitlement holders.
322	1	NEPAGEN - NEPA Process	Reclamation's analysis and implementation of a consensus-based negotiated proposal that fully satisfies the identified purpose and need of the SEIS along with the no-action alternative is reasonable. The Arizona Agencies recommend that the Dear Reader Letter be revised to support the use of a single action alternative under NEPA.	Thank you for your comment. Any Reclamation decisions regarding how to proceed will be described in the record of decision.

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410	7	NEPAGEN - NEPA Process	Not only does this all-encompassing caveat waive away Reclamation's responsibility under its NEPA Handbook to discuss [a]ll impacts to trust assets, even those considered nonsignificant, . . . in the trust analyses in NEPA documents and to implement appropriate compensation or mitigation, but it does so while frankly acknowledging that Reclamation's analysis of these impacts is preliminary and that it provides only the initial necessary information to assess impacts - in other words, that the analysis in the DSEIS is incomplete.32 This is plainly inadequate for NEPA purposes. NEPA requires a "useful analysis of the cumulative impacts of past, present, and future projects." 33 Consideration of cumulative impacts requires "some quantified or detailed information; ... [g]eneral statements about 'possible' effects and 'some risk' do not constitute a 'hard look' absent a justification regarding why more definitive information could not be provided."34 Nor is it appropriate for Reclamation "to defer consideration of cumulative impacts to a future date."35 Reclamation's self-described "preliminary" analysis of "only initial necessary information" concerning the impact of its alternatives did not constitute the "hard look" that the agency is obligated to provide, and thus fell short of what NEPA requires. In order to satisfy its trust responsibility and obligations under NEPA, Reclamation must undertake the investigation and analysis necessary to examine the impacts of the Proposed Action on the Nation's SAWRSA settlement and Reclamation's obligations thereunder, and to prioritize the protection of the Nation's SAWRSA entitlement in this process. B. The Revised DSEIS must adequately address the Nation's unquantified Winters rights. As noted above, the ITAs analyzed in the Revised DSEIS include federal reserved Indian rights to Colorado River water including rights established pursuant to Arizona v. California, Colorado River water Tribal delivery contracts where such contracts are part of a congressional approvedE85	The risk of additional involuntary shortages is low, and Reclamation would not impose additional involuntary shortages without appropriate coordination and consultation. The analysis in the SEIS does not modify any entitlement or applicable statutory, settlement, or contract terms.
120	1	OOS - Out of Scope	On August 8, 2023, the City of Boulder City entered into an agreement with a private company to deliver treated waste water- Agenda Item 8. For possible action: Resolution No. 7677, a resolution of the City Council of Boulder City, Nevada approving Agreement No. 23-2049 between the City of Boulder City and Quarry 187, LLC for reuse of the City's treated wastewater. On August 23, 2023, Quarry 187 sold 300 acres of their land to Amazon.com Services, LLC and 94 acres of their land to DIV Industrial Partners EDV, LLC. Amazon and DIV Industrial plan to build warehouses on this land in Eldoraldo Valley, Nevada. I, as a resident of Boulder City, Nevada don't understand this agreement. Boulder City has told its residents that they are going to remove a lot of grass etc. from our various parks because we have a shortage of treated waste water to water our parks. Boulder City, Nevada also owns three public golf courses where our treated waste water is used to water the public golf courses. I don't understand how Boulder City also can enter into an agreement with a private company to provide our treated waste water if we have a shortage of treated waste water to put on our parks and three public golf courses. Apparently, Boulder City has been selling our treated waste water to Quarry 187 and now Amazon.com Services, LLC and DIV Industrial, LLC since 1962, renewing the agreement every five years. Why would our city, Boulder City, Nevada be selling our treated waste water to two private corporations located in the City of Henderson when we are suppose to have a shortage of water? On Oct 1, 2023, our water and electricity bill went up.	Thank you for your comment; however, this comment is outside the scope of the SEIS.

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290	10	OOS - Out of Scope	3.4 The fact is that two attempts by State to find the solution for saving and restoring the Salton Sea were "sabotaged" by a relatively small group of people associated with local leaders and members of the Salton Sea Authority. 3.4.1 NOTE: - My proposal which is architectural plan for saving and restoring the Salton Sea was rejected (sabotaged) twice without a single scientific argument against it. My proposal was excluded from evaluation based on ridiculous criteria inserted by a relatively small group of people associated with local leaders and members of the Salton Sea Authority. (See section 5.3.2; 5.3.7 - 5.3.8.1)	Management of the Salton Sea is not within the scope of this SEIS.
290	12	OOS - Out of Scope	4.1.1 NOTE: Came to my attention a report, prepared for policymakers and stakeholders by the UNIVERSITY OF CALIFORNIA RIVERSIDE SALTON SEA TASK FORCE Sponsored by the EDGE Institute and the Center for Science to Policy published on July 2021. Titled "CRISIS AT THE SALTON SEA" subtitle: "The Vital Role of Science". Here is the link to the report: 0d73bf_f8133ee80a30473ca565ecab181e31a1.pdf (ucr.edu). Or alternative link: https://www.saltonseataskforce.ucr.edu/_files/ugd/0d73bf_f8133ee80a30473ca565ecab181e31a1.pdf. 4.1.2 NOTE: In the first paragraph of the report (link above), is mentioned the disconnect between higher officials and agencies stating that a combination of mismanagement and competition among federal, state, and local agencies exists.	Management of the Salton Sea is not within the scope of this SEIS.
303	8	OOS - Out of Scope	the Colorado River community must use the time and resources available wisely to develop a full range of reasonable operating alternatives and analyze the reasonably identifiable impacts of such alternatives on the Colorado River's natural, social, and cultural and economic resources, wherever they occur in the basin.	The range of alternatives analyzed in this SEIS is reasonable. Action Alternatives 1 and 2 were considered in the original Draft SEIS but were ultimately dismissed from detailed analysis in the revised Draft SEIS because their performance was similar to or worse than the Lower Division proposal (now the Proposed Action) as explained in the Dear Reader Letter to the Revised Draft SEIS and Section 2.8. Reclamation analyzed the Lower Division Proposal (now the Proposed Action) at the request of the Seven Basin States, and that analysis shows that the Proposed Action balances the risk between Lake Mead and Lake Powell better than the alternatives considered in the Original Draft SEIS. The current range of alternatives thus meets the purpose and need to address low reservoir conditions across the Basin in the short term and, perhaps more importantly, provides the space "so that all parties can focus their resources on the development of the post-2026 guidelines" as described by the Seven Basin States. The analysis in Chapter 3 of the SEIS evaluates the direct and indirect impacts of the Proposed Action and No Action on the natural and human environment.

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310	20	PALEO - Paleontology	In Section 3.12, Paleontological Resources, there are several problems. 3.12.1 Affected Environment states: "Paleontological resources include (with some exceptions) any fossilized remains, traces, or imprints of organisms preserved in or on the earth's crust." Paleontological specimens may be above ground, embedded in the rocks, or below the waterline and may be anywhere within the Colorado River basin (e.g., between Lake Powell and Lake Mead). The RDSEIS description of paleontological resources leaves out microfossils which are not traces. Microfossils are important in establishing the environment in which animals, plants, insects, and other organisms lived. These fossils establish flora, fauna, and sometimes the temperature of the environment. Microfossils are a common feature in marine environments, brackish water, freshwater, and terrestrial sedimentary deposits. Every kingdom of life is represented in the microfossil record. It is important to differentiate between archeology "the study of the human past, which encompasses a small part of life on this planet" and paleontology, which goes back many millions of years. These two are not the same, but in this document, they are lumped together repeatedly. In both the No Action Alternative and Proposed Action, there is no way to know what the river levels will be at any given time. Paleontological resources cannot be reestablished once they are gone. We urge ongoing study to minimize the impacts on paleontological resources all along the Colorado River, including the Salton Sea, to minimize damage from weather, visitors, construction, and vandalism to these vital fossils, including tracks, traces, imprints, plants, insects, and microfossils.	The definition of paleontological resources is taken from the PRPA which guides the analysis and is the basis of the limited discussion of the affected environment. It can be assumed that scientifically important paleontological microfossils may be present. But there is no data developed to assume that there would be a different level of impact to microfossils than other fossil resources or that their locations and significance are rare and threatened. There is no confusion about the difference between archaeology and paleontology but the discussion of the patterns of potential exposure of paleontological resources from changing river flows or lake levels is analogous.
557	13	PALEO - Paleontology	In part 3.12 "Paleontological Resources," the Revised Draft SEIS correctly states that "a relatively complete geologic record of fossil-bearing sediment has been deposited" in the northern Salton Trough during the past 7 million years, and that "[p]aleontological remains are widespread and very diverse." While the Revised Draft SEIS acknowledges "[t]here is the potential for paleontological resources to be present within the playa margins," it does not properly discuss the fact that the Proposed Action could result in the exposure, degradation, and loss of important paleontological resources at the Salton Sea; nor does it suggest appropriate actions to avoid those adverse impacts, or to minimize them if avoidance is impossible. The Revised Draft SEIS poses the question, "Issue 2: How would changes in river flow from Lake Mead water releases and from equalizing and balancing Lake Mead and Lake Powell affect paleontological resources along the river and the Salton Sea shore?" The "Summary" text then states, "No additional impacts on resources at the Salton Sea would occur under either alternative."50 The Revised Draft SEIS presents no support for this conclusory and erroneous statement. [See comment letter for additional details]	The extent of any exposed shoreline would be within the same range of fluctuations as existing conditions. This SEIS analyzes impacts at the point of delivery, therefore, impacts to the Salton Sea have been described under cumulative effects. Topics mentioned by the commenter are being analyzed in separate NEPA efforts such as the USACE Salton Sea Management Program Phase I: 10-Year Plan EA and the IID 2024-2026 Temporary Colorado River System Water Conservation Project.

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288	37	PI - Public and Stakeholder Involvement	Reclamation must ensure no overlap between public comment periods for Colorado River environmental review processes under NEPA. The Trust understands that Reclamation is undertaking several environmental review processes under the National Environmental Policy Act (NEPA) that relate to the Colorado River and that there is urgency for the agency to move through these processes in timely manner. Our concern, however, is when these processes, in the same geography and cover similar issues, have public engagement periods that overlap. For example, this Revised Draft SEIS was released for public comment on October 25, 2023. At the same time, however, the 30-day public comment scoping period on Reclamation's Supplemental Environmental Impact Statement for the revision to the LTEMP SEIS was still underway. The notice of intent for the LTEMP SEIS was published on October 4, 2023 and the 30-day comment period closed on November 3, 2023. The overlap of the two processes was nearly 10 days. Many of the same stakeholders and sovereigns are engaged in several if not all these NEPA processes (e.g. SEIS Near-term Operations, LTEMP SEIS, Post-2026 Guidelines) or would be if they had the capacity and resources. To ensure the opportunity for the public and impacted parties to engage and provide robust feedback in these important forums that involve common issues, geography, and stakeholders, we ask the Reclamation take this into consideration when it schedules NEPA processes for the Colorado River and work to avoid such overlap.	Thank you for your comment. Reclamation is seeking to avoid overlapping comment periods for Colorado River NEPA efforts where feasible.
302	9	PI - Public and Stakeholder Involvement	The Colorado River Basin is stuck in a hydraulic trap and the only viable solution is to create a new and different beginning where public interest considerations finally play a role in management.	Thank you for your comment.
550	5	PI - Public and Stakeholder Involvement	4. We encourage the Bureau to implement a regular dialogue with the general public in order to share status, issues that are arising, and solicit general feedback on the process.	Noted.
288	4	PN - Purpose and Need	The purpose and need for the near-term revision of the 2007 interim guidelines is too narrow to facilitate holistic solutions to sustain the Colorado River and its resources.	The purpose and need is sufficient to meet the low-runoff conditions in the basin until the Post-2026 process is complete.
288	5	PN - Purpose and Need	The Revised Draft SEIS must "briefly specify the underlying purpose and need to which the agency is responding in proposing the alternatives including the purposed action." 40 C.F.R. § 1502.13. However, the agency cannot "define the project so narrowly" that it forecloses reasonable consideration of alternatives to the proposed action. .19	The purpose and need is sufficient to meet the low-runoff conditions in the basin until the Post-2026 process is complete.

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288	7	PN - Purpose and Need	The purpose and need statement narrowly focus on reservoir elevations at Lakes Powell and Mead and the impact of reservoir elevations on "operations" during the 2023-2026 interim period. It emphasizes the threat as climate but fails to recognize the role unsustainable demand has and will continue to play in the decline of reservoir elevation. The focus is on ensuring the dams "operate under [their] intended design." In so doing, Reclamation specifically contemplates "impacting downstream resources" and "reservoir elevations at Lake Mead." Id. Protecting infrastructure over all else "when other resource considerations are mandated by statutes like the Grand Canyon Protection Act of 1992 and the Endangered Species Act" is too narrow a view when establishing the purpose and need and forecloses alternatives that should be considered. With a slightly broader purpose and need, Reclamation could have factored a more holistic view into the policy revisions and allowed them to inform the amount of necessary water conservation- an amount not only to prevent the system of water distribution on the Colorado River from collapse, but to ensure that the Colorado River itself and the resources and interests it supports are included and protected. The purpose could be to supplement the 2007 Interim Guidelines to modify guidelines for operation of the Glen Canyon and Hoover Dams to address historic drought, historically low reservoir elevations, and low-runoff conditions impacting the Colorado River and its unique resources by adjusting demand. Likewise, the need should acknowledge the necessity of safeguarding downstream resources along the Colorado River as follows: The need for the modified operating guidelines is based on the potential that continued low-runoff conditions in the Basin could lead Lake Powell and Lake Mead to decline to critically low elevations, impacting operations, water availability, and safeguarding downstream environmental, cultural, and recreational resources along the Colorado River including endangered and threatened species through the remainder of the interim period (prior to January 1, 2027).	The purpose and need is sufficient to meet the low-runoff conditions in the basin until the Post-2026 process is complete.
288	9	PN - Purpose and Need	Reclamation needs to demonstrate through action that it is committed to taking a more holistic view of the river and its resources and that think beyond and plan for operating beyond thresholds even in the short-term. This acknowledgement could start by simply broadening the purpose and need of the proposed action to recognize the river itself, the environment, and the resources that could be impacted.	The purpose and need is sufficient to meet the low-runoff conditions in the basin until the Post-2026 process is complete.

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310	24	PN - Purpose and Need	The Purpose and Need for the proposed action must include ecosystem protection. At least thirteen, and up to twenty-two animal species have been extirpated from the Colorado River ecosystem since Glen Canyon Dam closed in 1963 (Glen Canyon Dam Adaptive Management Program 2020, Stevens n.d.), and non-native plant species are now prevalent in riparian habitats. Three of eight native mainstem fish (Colorado pikeminnow, bonytail chub, roundtail chub) have been extirpated from Grand Canyon, and four more (humpback chub, razorback sucker, flannelmouth sucker, and bluehead sucker) require intensive management to avoid serious decline. (United States National Park Service Grand Canyon National Park 2023). At one time, the razorback sucker was thought to be extirpated, but it has since been found in newly exposed river segments above Lake Mead. Changes in all aspects of the natural flood regime threaten the survival of riparian and aquatic species: flow magnitude, frequency, duration, timing, and rate of change across hourly to century scales (Poff et al. 1997, Schmidt and Grams 2011). The effects of this problem were recognized decades ago, leading to an important mandate from Congress to mend the river ecosystem: The Secretary shall operate Glen Canyon Dam "in such a manner as to protect, mitigate adverse impacts to, and improve the values for which Grand Canyon National Park and Glen Canyon National Recreation Area were established, including, but not limited to natural and cultural resources and visitor use." (Grand Canyon Protection Act of 1992, Pub. L. 102-575, title XVIII, Oct. 30, 1992, 106 Stat. 4669, Section 1802(a)). Although Reclamation acknowledges that water releases "can include maximum and minimum flow rates; safety restrictions to protect downstream facilities or water uses; considerations to meet ecological conditions, such as the time of year or temperature when water is released; or physical limits where water can no longer be released," RDSEIS, p. 1-9), Reclamation is dodging the fact that these considerations must be included to meet the requirements of the law. Rather than avoiding ecological considerations, Reclamation must change the Purpose and Need to reflect its legal requirement to protect, mitigate adverse impacts to, and improve the Grand Canyon. Recommendation 4: Include within the Purpose and Need of the Near-term Colorado River Operations the protection and restoration of the Colorado River ecosystem in the Grand Canyon as required by the Grand Canyon Protection Act, the Endangered Species Act, and the purpose and significance of Grand Canyon National Park.	Impacts and benefits to ecosystems are addressed in the SEIS analysis but are not the reason Reclamation is taking action. As discussed in detail in Section 1.3, the purpose and need for Reclamation to take action under this SEIS is to supplement the 2007 Interim Guidelines for operation of the Glen Canyon and Hoover Dams to address historic drought, historically low reservoirs, and low-runoff conditions in the Basin to prevent Lake Powell and Lake Mead from declining to critically low elevations. As such, Reclamation's proposed action for this SEIS is to mitigate impacts from ongoing trends in the Colorado River System. There are limited resources for which mitigation might be appropriate in the case of the voluntary conservation actions considered in this SEIS. Biological mitigation measures will be identified in the Biological Opinions issued by the USFWS related to this SEIS.

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484	6	PN - Purpose and Need	The hydrology in winter and spring 2023 marginally improved system storage. However, the purpose and need for the SEIS has not changed. The Preferred Alternative must meet the SEIS purpose and need. The No Action Alternative does not meet the purpose and need for the SEIS. The No Action Alternative does not protect the system from collapse in case of continuing dry hydrology, and it does not offer sufficient tools for Reclamation to address low reservoir elevations and to operate the system more sustainably. Moreover, the Proposed Action Alternative may also not meet the purpose and need. The Proposed Action Alternative relies on voluntary Lower Basin reductions through agreements, some of which have yet to be executed and may not be signed until after a Record of Decision is issued for this SEIS. This may not create sufficient additional tools for Reclamation to address the projected ongoing drought conditions and may prove insufficient to protect Lake Powell and Lake Mead. The UCRC acknowledges that Secretarial actions to reduce releases from Glen Canyon Dam may be needed under the Revised Draft SEIS if Lake Powell's elevation in the minimum probable forecast is projected to drop below 3,500 feet in the following 12 months. Actions pursuant to Section 7.D. of the 2007 Interim Guidelines are discussed in the Purpose & Need section of the Revised Draft SEIS and, in that section, the Department of the Interior finds that extraordinary circumstances currently exist. Reduced releases from Glen Canyon Dam that may result from the SEIS shall not constitute an action by the Upper Division States or the UCRC for the purposes of determining compliance with Article III of the 1922 Compact. Any revision to Section 6.C of the 2007 Interim Guidelines must be taken pursuant to Secretarial authority only and will not constitute consent, endorsement, or acquiescence from the Upper Division States.	The no action alternative is required pursuant to NEPA. See 40 CFR Section 1502.14. The Proposed Action does meet the purpose of and need for the SEIS to address low reservoir conditions at Lake Powell and Lake Mead. Analysis of the Proposed Action was supported by the seven Basin States, and the analysis showed that the Proposed Action balances risks between Lake Powell and Lake Mead better than the operational tiers considered in Action Alternatives 1 and 2, as demonstrated in the graph on p. 2 of the Dear Reader Letter to the Revised Draft SEIS. Any actions taken under the Secretary's reserved authority to protect Congressionally authorized infrastructure are reserved to the Secretary and will be taken independent of any consent, endorsement, or acquiescence of others.
548	3	PN - Purpose and Need	1.3 PURPOSE OF AND NEED FOR ACTION (1-10): Reiterating the comment above, "protecting infrastructure" should be clear that this objective/need refers to the hydropower purpose.	The reference to infrastructure, as currently drafted, is intended to capture the range of authorized purposes for Glen Canyon Dam.
115	3	POLICY - Policy and Legal Compliance	For the reasons explained below, our Indian water rights are playing a critical role in the Upper Basin states' delivery of water to the Lower Basin states, as required under the 1922 and 1948 Colorado River Compacts. Every effort by the Federal Government now and into the future related to the Colorado River Basin should include consideration, evaluation, analysis, and an explanation of our Tribe's Indian water rights and the effect of the Federal Government's decisions and policies on our development and use of these property rights. [See comment letter for additional details.]	Reclamation continues to work on settling tribal water rights. Reclamation is committed to the discussion of tribal water rights claims with individual tribes that is beyond the short timeframe covered by this SEIS, and consultation is ongoing.
115	9	POLICY - Policy and Legal Compliance	With tribal involvement at this critical juncture, non-Indian, state water users and the Federal Government will have greater certainty and finality regarding the Colorado River water supply and its use. Do not relegate the Department's evaluation of its decisions about adverse impacts on Indian reserved water rights in the Colorado River to the conclusory statement that "Tribal water rights are established by settled law." This continued approach will not protect our Tribe's Indian reserved water rights in the Upper Colorado River Basin.	Reclamation continues to work on settling tribal water rights. Reclamation is committed to the discussion of tribal water right claims with individual tribes that is beyond the short timeframe covered by this SEIS, and consultation is ongoing.

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138	5	POLICY - Policy and Legal Compliance	The first component of the 2007 Interim Guidelines is,"improve Reclamation's management of the Colorado River by considering trade-offs between the frequency and magnitude of reductions of water deliveries, and considering the effects on water storage in Lake Powell and Lake Mead, and on water supply, power production, recreation, and other environmental resources; The 2020 review of the 2007 plan found that the BOR was "largely effective". BlueRibbon believes that in the case of recreation, BOR was not effective as we have seen recreational resources such as marinas and ramps closed due to water levels. There have been "experimental releases" that should not be implemented during times of drought.	Discussion of the current state of recreation in the project area and the challenges posed to recreation by long-term drought is included in Section 3.14.1 of the SEIS. HFEs are governed by LTEMP and are outside the scope of this SEIS.
283	6	POLICY - Policy and Legal Compliance	Second, in May 2023, after the original draft SEIS was issued, the Lower Division States proposed an alternative for approximately 3 million acre-feet of water to be conserved to protect critical levels at Lake Mead ("Lower Division Proposal") (Lower Basin Plan Letter - May 22, 2023). The Upper Division States recommended that this proposed alternative be analyzed in the NEPA process (Seven States Letter - May 22, 2023). After the Lower Division Proposal was submitted, Reclamation temporarily withdrew the original draft SEIS so that it could fully analyze the effects of the proposal under the NEPA. As a starting point, the BOR must consider its obligations under the Grand Canyon Protection Act (GCPA) and to the maximum extent possible demonstrate how each alternative being considered in the SEIS meets these legal obligations. Specifically, the key mandate of the Grand Canyon Protection Act of 1992 states, "The Secretary shall operate Glen Canyon Dam... in such a manner as to protect, mitigate adverse impacts to, and improve the values for which Grand Canyon National Park and Glen Canyon National Recreation Area were established, including, but not limited to natural and cultural resources and visitor use." (Section 1802, GCPA).	Both alternatives are consistent with the GCPA. This SEIS concerns annual releases through the Grand Canyon, but the implications for more particular subannual releases are described in Section 2.7.2.
284	4	POLICY - Policy and Legal Compliance	Although the Districts support the voluntary, compensated conservation underpinning the Proposed Alternative, the Districts have a significant interest in how the Bureau would implement certain aspects of the Proposed Alternative under near-term dry hydrologies. The primary subject of concern is the expedited decision-making process that the Proposed Alternative would authorize the Bureau to implement when the April 24-month study's minimum probable elevation projected for Lake Mead is below 1025 feet. See, e.g., RDSEIS at 2-8 (Lower Basin States, in consultation with Upper Basin States, will have 45 days calendar days to propose a plan to prevent Lake Mead from reaching 1000 feet; if such plan "is not acceptable to" the Bureau, then the Bureau may take "additional action" to protect 1000 feet). The Districts emphasize that, if the expedited process is triggered, the Bureau must abide by all federal laws, notwithstanding the exigency of that situation. Those laws include the federal laws that comprise portions of the Law of the River; the Administrative Procedure Act, 5 U.S.C. SSSS 701 et seq.; and the National Environmental Policy Act ("NEPA"), 42 U.S.C. SSSS 4321 et seq. This portion of the Proposed Alternative, although it envisions swift action under critical conditions, cannot be a license to disregard the priority system, the analysis and notice requirements of NEPA, or any other legal requirement.	For all operations, the Secretary reserves the right to operate Reclamation facilities to address extraordinary circumstances, as described in Section 7(D) of the 2007 Interim Guidelines, including “operations that are prudent or necessary for safety of dams, public health and safety, other emergency situations, or other unanticipated or unforeseen activities arising from actual operating experience.”

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284	5	POLICY - Policy and Legal Compliance	The Bureau must at all times allocate water deliveries and reductions according to the priority system encoded in the Law of the River, which operates as follows. The Bureau, on behalf of the Secretary of the Interior, first satisfies present perfected rights ("PPRs") without regard to state lines. Arizona v. California, 376 U.S. 340, 342 (1964); 43 U.S.C. SS 1521; Arizona v. California, 547 U.S. 150, 155 (2006). The Bureau then satisfies non-PPR users with contract dates prior to 1968 ("middle-priority users") before satisfying post-1968 users, as stated in the Colorado River Basin Project Act ("CRBPA"). 43 U.S.C. SS 1521(b). The CRBPA makes clear that the Bureau has a mandatory duty to satisfy the Districts' entitlements--which date prior to 1968--before it can deliver water to any users with post-1968 contract dates. All parties have long recognized that water is allocated in this way. See, e.g., Director's Shortage Sharing Workgroup Recommendation, October 24, 2006 at 2 (prepared by Arizona Department of Water Resources workgroup and recognizing that users at Arizona Priority 4 and lower are reduced before reducing users at Arizona Priority 3).One area in which the Bureau may have some limited discretion is in apportioning water to middle-priority users when insufficient water is available to fill all water orders, even after reducing junior-priority users' deliveries to zero. The Bureau must apportion that water equitably and consistently with the larger legal framework. That act of apportionment is a federal function, and is not subject to approval by State legislatures. See 43 U.S.C. SS 617c (providing for contracts directly between the Bureau and water users). In delivering water according to this priority system, the Bureau must engage in the suite of processes under 43 C.F.R. Part 417, which requires it to ascertain every year that each delivery of Colorado River water to "every public or private organization ... in Arizona, California, or Nevada which ... has a valid contract for the delivery of Colorado River water" "will not exceed those reasonably required for beneficial use," according to a number of factors. Id. SSSS 417.1-417.3; see also id. SS 417.5 (governing deliveries to Tribes). Part 417 applies to agricultural and municipal areas alike. To the extent the Bureau has exempted municipal and industrial users pursuant to 43 C.F.R. SS 417.1(b), those exemptions can no longer be justified given the scale of municipal and industrial water use and the challenges facing the River. Moreover, the Bureau has long recognized that Part 417 applies to both PPRs and junior-priority users. See, e.g., Federal Defendants' Brief Regarding Remedy for 43 C.F.R. Part 417 Breach Found by Court on Motion for Preliminary Injunction at 1, Imperial Irrigation District v. United States, No. 03-cv-00069 (S.D. Cal. 2003) (agreeing with court's finding that Part 417 applied to Imperial Irrigation District's PPR entitlements). Part 417 uses mandatory language: The Bureau must determine that deliveries "will not exceed those reasonably required for beneficial use." 43 C.F.R. SS 417.2 (emphasis added).	Thank you for your summary of the Arizona priority system, which is further discussed in Appendix E. Implementation of 43 CFR Part 417 is an annual process that will continue independent of Colorado River operating guidelines.

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284	6	POLICY - Policy and Legal Compliance	The APA imposes additional requirements on the Bureau. The Bureau may not unlawfully withhold or unreasonably delay mandatory acts; cannot act in a manner contrary to law; must not be arbitrary or capricious in making discretionary decisions; and must have substantial evidence for any fact-based decisions. 5 U.S.C. SS 706. Those principles require the Bureau to abide by the Law of the River, including by implementing the priority system upon which multi-billion dollar economies have long relied. Indeed, even if the priority system were purely a creature of the Bureau's administrative powers, the Bureau would need exceedingly persuasive justifications for departing from that system. See, e.g., Smiley v. Citibank (S. Dakota), N.A., 517 U.S. 735, 742 (1996) (citing United States v. Penn. Indus. Chem. Corp., 411 U.S. 655, 670-675 (1973); NLRB v. Bell Aerospace Co., 416 U.S. 267, 295 (1974)).	Comment noted.

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284	7	POLICY - Policy and Legal Compliance	Finally, the Bureau must comply with NEPA. NEPA requires the Bureau to analyze the direct and indirect effects of a decision of the magnitude of the present proceedings--or proceedings in the event of a projected low elevation of Lake Mead--in an environmental impac statement ("EIS") or supplemental environmental impact statement ("SEIS") with reasonable specificity. See 40 C.F.R. SS 1508.1(g) (discussing direct and indirect effects). The Ninth Circuit has repeatedly insisted that "general statements" about future impacts do not satisfy NEPA. Or. Nat. Res. Council Fund v. Brong, 492 F.3d 1120, 1134 (9th Cir. 2007). Thus, an EIS for an oil H152 Thus, any EIS or SEIS concerning restrictions on Colorado River water usage must analyze environmental impacts at the level of the specific users denied water, which the RDSEIS does not do. Under present circumstances, it will not suffice to note, as the agency erroneously did in Center for Biological Diversity, that usage of a resource might generally increase or decrease. 982 F.3d at 722. Rather, the agency must determine the impacts of that increase or decrease, including how people who depend directly or indirectly on water from the Colorado River will foreseeably substitute for its loss--especially where changes in land use will result. That analysis must start with clearly identifying where, precisely, reductions in water usage will occur. The Bureau must be candid about those reductions to allow the public and the Bureau itself to meaningfully evaluate their impacts. Such specificity is critical because those impacts vary across different users, both in Arizona and across the Lower Basin. The environmental impacts of sustaining or ending Yuma's high-efficiency, high-value agricultural production differ markedly from, for example, the environmental impacts of altering water usage in high carbon- usage suburbs or water-inefficient low-value agriculture elsewhere in the Basin. Of particular significance, absent some future analysis, imposing water delivery reductions that the final DSEIS does not model would violate NEPA. The RDSEIS neither contemplates nor analyzes shortages in the water deliveries to Arizona Priority 3, and thus does not itself provide sufficient support under NEPA to effect reductions to that group. See RDSEIS at 3-81, E-10. Additionally, the RDSEIS analyzes reducing deliveries in the Lower Basin by at most 2.083 million acre-feet; shortages greater than that amount must be modeled and analyzed before they can be implemented. See id. at 3-60. Modeling any reduction before it is imposed is especially important for environmental justice communities like Yuma County. See id. at 3-321, 3-329 (discussing impact of hydropower on environmental justice communities). A final DSEIS that repeats these omissions will not provide sufficient analysis under NEPA for involuntarily reducing the Districts' water deliveries, even under drought conditions that trigger the expedited decision making process described above.	Reclamation prepared this SEIS to analyze the potential environmental effects of the proposed action. Reclamation has taken a hard look at the Proposed Action and analyzed the environmental effects. Chapter 3.7 of the SEIS analyzes impacts to water deliveries. As described in Section 3.3, a Shortage Allocation Model was used in addition to the CRMMS to analyze the potential impacts of the alternatives on individual water users within each Lower Division State. The Shortage Allocation Model was used to estimate delivery of water to Colorado River water users within the Lower Division States under varying levels of shortage. Further, section 3.16 of the SEIS analyzes impacts on agriculture, and presents the available data on agriculture and agricultural resources in Yuma County and other counties in Arizona. The SEIS, for example, recognizes that Yuma County alone produces 75 percent of the state's total vegetable crops and that, in 2017, production values ranged from a low of approximately $17.1 million in La Paz County to a high of $1.2 billion in Yuma County. Finally, as noted in Section 2.7, Proposed Action, "Whenever Lake Mead's content is projected to be below an elevation of 1,025 feet, based on the April 24-Month Study minimum probable projection, the Lower Division States, after consultation with the Upper Division States, would have 45 calendar days to provide Reclamation with an implementation plan to protect Lake Mead from reaching an elevation of 1,000 feet. If an implementation plan is not acceptable to Reclamation, then Reclamation may take additional action to protect 1,000 feet." This SEIS does not project or limit what those additional actions may be, and does not foreclose Reclamation conducting necessary additional environmental compliance.
285	3	POLICY - Policy and Legal Compliance	The SSMP's habitat and dust suppression projects have yet to meet the existing requirements for the last water transfer agreement, either under statute (CA Fish & Game Code SS2940 et seq.) or pursuant to Order WRO 2017-0134. It is not appropriate to suggest that they are sufficiently robust to mitigate the impacts of additional inflow reductions due to water conservation efforts in the Imperial and Coachella valleys.	This SEIS analyzes impacts at the point of delivery. Site-specific impacts are being analyzed in US Army Corps of Engineers' Salton Sea Management Program Phase 1: 10-Year Plan Environmental Assessment and IID 2024-2026 Temporary Colorado River System Water Conservation Project EA.

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285	5	POLICY - Policy and Legal Compliance	Future Actions Should Be Contingent on Completion of Previously Required Mitigation Reclamation's approval of system conservation implementation agreements (SCIA), or any other water supply reduction agreements with IID in the years 2024-2026 inclusive, must be made contingent on the following actions by the State of California. Reclamation can exercise its discretion to execute any additional SCIA contracts with IID to ensure that previously committed mitigation will be implemented, as a partial measure to reduce the magnitude of cumulative impacts that will be caused by additional decreases in inflows to the Salton Sea and the subsequent rise in salinity, loss of additional habitat, and exposure of additional dust-emitting playa. The following actions by the State of California do not represent new or additional obligations; they are needed to meet prior state obligations and commitments. 1. Enactment of AB 1567, the Safe Drinking Water, Wildfire Prevention, Drought Preparation, Flood Protection, Extreme Heat Mitigation, Clean Energy, and Workforce Development Bond Act of 2024, at or above its current level of $400 million to provide air quality, public health, and habitat benefits to the Salton Sea and surrounding communities;	See Section 3.5.2 for information about how additional impacts on the Salton Sea from shoreline exposure are analyzed through other processes. Reclamation does not have the authority to mandate water user completion of previous mitigation agreements it is not a party to. IID and the State of California have their own authorities not controlled by Reclamation. Reclamation's potential contribution of funds through contribution agreements does not affect the enforcement mechanisms covered by those state and local authorities.
285	6	POLICY - Policy and Legal Compliance	The following actions by the State of California do not represent new or additional obligations; they are needed to meet prior state obligations and commitments. 2. Restoration of the previously committed $119 million for SSMP funding, in addition to the funds authorized by AB 1567;	Thank you for your comment.
285	7	POLICY - Policy and Legal Compliance	The following actions by the State of California do not represent new or additional obligations; they are needed to meet prior state obligations and commitments. 3. California's appropriation of operation and maintenance funding for existing SSMP projects and operation and maintenance funding for the SCH project;	Thank you for your comment.

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285	8	POLICY - Policy and Legal Compliance	The following actions by the State of California do not represent new or additional obligations; they are needed to meet prior state obligations and commitments. 4. Full operation and function of at least half of the acreage of the SCH project. Reclamation's approval of system conservation implementation agreements, or any other water supply reduction agreements with Coachella Valley Water District (CVWD) in the years 2024-2026 inclusive, must be made contingent on CVWD making water available, at IID's current "blended" CVWD transfer cost, to the proposed North Lake Pilot Demonstration Project, for the proposed life of that project. Although this small pilot demonstration project will not create much aquatic habitat, it will be an important step forward for Salton Sea restoration in Riverside County and will provide valuable construction and operational experience on the north side of the lake, as well as important recreational benefits to communities in the area that will be adversely affected by the lake's accelerated decline. It is reasonable to deliver water to this proposed project as partial mitigation for these additional water reductions and to begin to improve conditions at the Salton Sea.Sections 3.8, 3.9, 3.13, 3.16, and 3.17 of the SEIS (summarized in Table 2-9) note that the proposed action would adversely affect water quality, air quality, biological resources, socioeconomics, and environmental justice in the Salton Sea region, for a period of 26 years. The SEIS incorrectly dismisses these 26 years of impacts, noting that they would be "greater under the Proposed Action for the next 26 years, but long-term impacts are the same as under the No Action Alternative." This is not consistent with conventional understanding nor legal interpretation of "long-term impacts."1Mitigation is appropriate and necessary for 26 years of adverse impacts and should be described and undertaken by Reclamation if the proposed action is approved and implemented. Inadequacy of Proposed Mitigation As per NEPA requirements, all federal agencies must identify any adverse consequences that cannot be avoided and must consider appropriate measures for mitigating those adverse consequences on the affected environment.2 Furthermore, NEPA also requires inclusion of means to mitigate adverse environmental impacts.3 Additionally, when analyzing adverse consequences, federal agencies must look at both direct and indirect effects, with indirect effects defined as effects which are caused by the action and are later in time or farther removed in distance but are still reasonably foreseeable.4As currently written, the SEIS has no proposed mitigation action, erroneously based on the assumption that the additional impacts caused by the proposed action would diminish to the baseline after a period of 26 years and that implementation of the Salton Sea Management Program's 10-Year Plan would mitigate additional adverse impacts. Instead, we recommend the following mitigation action be implemented, in addition to the federal Salton Sea funding commitment.	This SEIS analyzes impacts at the point of delivery. Site-specific impacts are being analyzed in USACE's separate EA and in the IID 2024-2026 Temporary Colorado River System Water Conservation Project EA. Mitigation is appropriately addressed through these other NEPA processes.

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288	2	POLICY - Policy and Legal Compliance	While the Trust supports Reclamation's revision of the 2007 interim guidelines to expand its ability to address low runoff and reservoir conditions and memorialize additional water conservation in the lower basin, we also believe that Reclamation needs to comply with the law and expand the Revised Draft SEIS to fully analyze a range of additional operational policies related to reducing demand, the operational tiers, and mid-year review. Reclamations analysis will be rendered inadequate if a reasonable alternative exists, but it is not fully incorporated into the analysis	The range of alternatives analyzed in this SEIS is reasonable. Action Alternatives 1 and 2 were considered in the original Draft SEIS but were ultimately dismissed from detailed analysis in the revised Draft SEIS because their performance was similar to or worse than the Lower Division proposal (now the Proposed Action) as explained in the Dear Reader Letter and Section 2.8. As explained in the Dear Reader Letter to the revised Draft SEIS, Reclamation analyzed the Lower Division Proposal (now the Proposed Action) at the request of the Seven Basin States, and that analysis shows that the Proposed Action balances the risk between Lake Mead and Lake Powell better than the alternatives considered in the Original Draft SEIS. The current range of alternatives thus meets the purpose and need to address low reservoir conditions across the Basin in the short term and, perhaps more importantly, provides the space “so that all parties can focus their resources on the development of the post-2026 guidelines” as described by the Seven Basin States. In addition, the ability to reduce Lake Powell releases to 6.0 maf, the Secretary's ongoing reserved authority to take emergency actions, and the SEIS conservation in the Lower Basin states, show that the system is more protected than under the No Action Alternative.
288	36	POLICY - Policy and Legal Compliance	Even in this intentionally narrow process to obtain additional authorities, Reclamation can be more innovative and creative. As it stands, the same interests are protected that stand to benefit (water users, hydropower interests), while the same interests left to shoulder the burden (tribes and the environment) stand to lose. The tables need to be turned to distribute the burden, albeit painful, and Reclamation has at least some of the authority it needs right now to start this process. Reclamation needs to rethink how it can equitably distribute the burdens of the challenges ahead. The tribes, the ecosystem, and native fish can no longer shoulder this burden alone, nor should they be required to contribute additional water or face additional impacts. .98 Alternatives 1 and 2 meet more of those values than either the no action or proposed alternative. In the absence of a true ecosystem-based alternative, 99 at least Alternatives 1 and 2 developed by Reclamation are precautionary and contained an equity frame. As noted above, these alternatives were improperly eliminated from full analysis in the Revised Draft SEIS. This process would benefit significantly if Alternatives 1 and 2 were carried forward an analyzed, including a full effects analysis, prior to the issuance of a FEIS or ROD. Reclamation can meet the purpose and need of the federal action, the Law of the River, and comply with the mandates of the Endangered Species Act and Grand Canyon Protection Act, but to do so it needs to think more holistically about the solution going forward.	The range of alternatives analyzed in this SEIS is reasonable. Action Alternatives 1 and 2 were considered in the original Draft SEIS but were ultimately dismissed from detailed analysis in the revised Draft SEIS because their performance was similar to or worse than the Lower Division proposal (now the Proposed Action) as explained in the Dear Reader Letter to the Revised Draft SEIS and Section 2.8. Reclamation remodeled Action Alternatives 1 and 2 based on the June 2023 hydrology during preparation of the Revised DSEIS as discussed in the letter. The analysis showed that the Proposed Action balances risks between Lake Powell and Lake Mead better than the operational tiers considered in Action Alternatives 1 and 2, as demonstrated in the graph on p. 2 of the letter. Action Alternatives 1 and 2 were therefore moved to the alternatives considered but eliminated from detailed analysis section. The current range of alternatives meets the purpose and need to address low reservoir conditions across the Basin in the short term and, perhaps more importantly, provides the space “so that all parties can focus their resources on the development of the post-2026 guidelines” as described by the Seven Basin States. The 3.0 maf of additional SEIS conservation reduces the risk of involuntary shortages to all water users compared with the No Action Alternative because it provides for additional water to remain in Lake Mead, thereby increasing Lake Mead elevations.

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290	5	POLICY - Policy and Legal Compliance	2.4 (3.5.2) Salton Sea The Salton Sea's continuing decline in elevation and resulting exposure of the lake bed negatively impacts the surrounding communities and reduces the remaining habitat for fish and wildlife. The California Natural Resources Agency, the California Department of Water Resources, and the California Department of Fish and Wildlife are focused on implementing Phase I: 10-Year Plan (10- Year Plan) of the Salton Sea Management Program (SSMP) to improve conditions around the Sea. The 10-Year Plan was released in 2017 and then updated in 2018 to guide the State's projects at the Salton Sea over the next decade (2018-2028). The 10-Year Plan identifies a sequence of habitat and dust control projects around the perimeter of the Salton Sea (California Natural Resources Agency 2018 and 2021). The US Army Corps of Engineers is preparing an Environmental Assessment for the implementation of the 10-Year Plan projects. Of the total project area (29,800 acres), at least 50 percent will be used to create habitat for fish and wildlife that depend on the Salton Sea ecosystem, and the remainder will support projects to suppress dust (US Army Corps of Engineers 2022). 2.4.1 My Comment: Such statements indicate acceptance of destruction of the Salton Sea as a normal situation. That despite provided verifiable evidence that the "current course of action" is a "drive in wrong direction" and that there is an architectural plan that has solved all current problems of the Salton Sea. It is obvious that the IID has many "tentacles" in several agencies including BoR and CNRA. So far, it appears that the leadership in the IID which are also majority members of the SSA are in charge of the fate of the Salton Sea. The BoR and CNRA bear responsibility for allowing to lose control and for not enforcing its own policy (see your mission statement at section 2.1) which are based on the Environmental Law[1] and which has been violated in this case. The "current course of action" leads to a smaller, saltier, smellier, and more polluted Salton Sea with subsequent consequences and liabilities.	As described in Section 3.5.2, Salton Sea management is outside the scope of this SEIS and involves numerous entities and arrangements outside of Reclamation control. Section 3.5.2 discusses the Salton Sea and potential cumulative effects of this action.
290	9	POLICY - Policy and Legal Compliance	3.3 The fact is that the "current course of action" blatantly violates Environmental laws[1] which is a foundation of the State of California and Federal policies and regulations which fundamentally support initiatives towards a clean environment, clean air, clean water, resiliency to climate change, clean renewable energy, protection of the health of the population, and economy, etc.	Management of the Salton Sea is not within the scope of this SEIS.

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290	11	POLICY - Policy and Legal Compliance	4.1 Because there is an obvious disconnect between - higher officials (Governor, Secretaries of California Natural Resources Agency (CNRA), California Environmental Protection Agency (CalEPA), California Energy Commission, Bureau of Reclamation) that facilitate and enforce policies of the State which are based on environmental law[1] - and the Imperial Irrigation District (IID) through their close associates at the Salton Sea Authority (SSA) that promote their own policy that leads towards smaller, saltier, smellier and more polluted Lake - which means the destruction of the Salton Sea - which blatantly violate the State and Federal policies, I am respectfully recommending that after my proposal is thoroughly reviewed and officially accepted, that the BoR / DoI with cooperation with Wade Crowfoot, Secretary of CNRA, secretaries of , EPA, CEC, DoE, Governor Gavin Newsom, and U.S. Army Corps of Engineers open an investigation of this case, based on provided verifiable evidence, and form a "mechanism" (office of a special counsel or Commission) formed by the honorable members of the CNRA, EPA, CEC, DoE, BoR / DoI, USACE, and several relevant agencies and stakeholders, tasked with overseeing funding and implementation of the long-term solution for the restoration of the Salton Sea (my proposal) until its completion in 5-6 years period. After its completion, the Commission can be abolished or reduced to overseeing maintenance issues and appropriate distribution of the revenue of at least $500,000,000 per year.	Management of the Salton Sea is not within the scope of this SEIS.
290	20	POLICY - Policy and Legal Compliance	5.2 Although the "current course of action" leads to smaller, saltier, smellier, and more polluted Salton Sea - there is also organized attempt towards "pivoting" (changing) from the original design of a single lake (the "Perimeter/Brine Lake") - their concept which was officially accepted in 2016 - towards my concept which consist of three sections which was officially presented to local leaders in Long Range Plan Committee, CVWD, Palm Desert, CA on February 25, 2016, and at Request for Information (RFI) presentations at El Centro on May 21, 2018. Such "pivoting" (changing) at this stage after my proposal was "strangely" excluded from evaluation by the UCSC Panel and systematically ignored by the SSA for 10 years is illegal conduct ... it is an attempt to steal ... It is stealing in process - piece by piece. The North Lake is the first piece. Even if perpetrators do not know how to still properly because the projects need more contributing (cooperating) elements, it is still sealing. The North Lake is an essential part of my architectural plan. Most people might not be aware of such attempt nor of the existence of my proposal, but the issue was between me and a few local leaders. 5.2.1 NOTE: See "press release" published by Mr. Phil Rosentrater, Executive Director of the SSA at the time of formation of the "Enhance Infrastructure Financial District" on around October 24, 2018, in which Mr. Phil Rosentrater gave credit to Mr. Manuel Perez, Director of the SSA and supervisor at of Fourth District, Riverside County, and Mr. Marion Ashley, also supervisor, for the concept of the "North Lake". In the article they indicated that the Imperial County should do similarly at the southern part of the Lake which is in Imperial County. Here is the link to the document: https://drive.google.com/file/d/1vnuuxwEMKhgvK9ors1KKXYJokqvx0o5b/view?usp=sharing. 5.2.2 NOTE: The document" press release" published by Mr. Phil Rosentrater (the link is above) was made after I made several presentations to Mr. Manuel Perez directly (personally) and after I made official presentations at CVWD, Palm Desert on February 25, 2016, and at El Centro on May 21, 2018, where Mr. Bruce Wilcox, assistant Secretary	Management of the Salton Sea is not within the scope of this SEIS.

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290 *(cont.)*	20 *(cont.)*	POLICY - Policy and Legal Compliance *(cont.)*	for California Nature Resources Agency (CNRA) was present and in charge. 5.2.3 NOTE: Although Mr. Phil Rosentrater did not type date on his "press release", (see also segment 9.20) he did state in his letter the following: "A healthier, more prosperous Salton Sea is the intended result an Enhanced Infrastructure Financing District (EIFD) launched today by the Riverside County Board of Supervisors" (underline added). Just to be sure, I googled and find out that the board of supervisors voted to create an "Enhance Infrastructure Financing District"(EIFFD) on Tuesday, October 23, 2018. That is five months after Mr. Bruce Wilcox informed me in his letter (see section 9.22) that they will not use my concept. Neither Mr. Phil Rosentrater's "press release" nor Mr. Bruce Wilcox's letter to me was properly dated and I doubt that it was an unintentional omission. That indicates that the official "stealing" of my concept started on October 23, 2018, which proves my assertions that I made about the process of slowly stealing "piece by piece" of my original concept. By the way, I made a short presentation in front of SSA's Technical Advisory Group on May 14, 2014. Mr. Bruce Wilcox, Mr. Roger Shintaku, P.E., and the third person that did not have a business card (I do not remember his name) were present at the meeting. See also the article by Sammy Roth in the Palm Springs Desert Sun. Here is the link: Riverside County's new Salton Sea plan could generate $1 billion (desertsun.com). In this article is also shows manipulative conduct by Mr. Bruce Wilcox in selecting three proposals for consideration, and his vague plans for possible development in the future. Importation of seawater was mentioned as a possibility far away in the future, but his initial position was to keep the "status quo". That was also the position of the Imperial Irrigation District (IID) where Mr. Bruce Wilcox worked earlier. The video of presentations of all 11 proposals are accessible at: Salton Sea Public Workshop (granicus.com). Please see it. Although the recording is about 3 hours and 48 minutes long, it is worth seeing it.	*(See above.)*
297	18	POLICY - Policy and Legal Compliance	Additionally, Public Law 102-575, which includes the Grand Canyon Protection Act requires that Glen Canyon Dam be managed "in such a way as to protect, mitigate adverse impacts to and improve the values for which Grand Canyon National Park and Glen Canyon National Recreation Area were established, including, but not limited to natural and cultural resources and visitor use29." Public Law 102-575 has not been repealed and as such has to be acknowledged and used to establish the parameters of any EIS analysis.	Both alternatives are consistent with the GCPA. This SEIS concerns annual releases through the Grand Canyon, but the implications for more particular subannual releases are described in Section 2.7.2.
297	41	POLICY - Policy and Legal Compliance	While the disappearance of Lake Powell creates big challenges for many stakeholders, it has nonetheless created significant recreation opportunities in the park. The SEIS analyses and resource planning should have optimized management for this reality, pursuant to the mission of the NPS and Grand Canyon Protection Act.	Purpose and need for this SEIS not related to recreation; reference SEIS section discussing emerging recreational opportunities.
299	3	POLICY - Policy and Legal Compliance	The need for adequate Inflation Reduction Act funding: While the revised draft references that the Proposed Action is consistent with congressional actions to fund conservation, it does not address funding levels in any detail or timelines for providing that funding. Such details might be subject to ongoing negotiations, but recognition that those issues are key to the success of the Proposed Action should be included.	Reclamation continues to work on these issues; however, they are not within scope of this SEIS. There are other funding opportunities through Bucket 2 here: https://www.usbr.gov/lc/LCBConservation.html and https://www.usbr.gov/watersmart/.

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302	1	POLICY - Policy and Legal Compliance	The "improved hydrology" that Reclamation relies on is not an exceptional amount of water and by relying on a single wet year for the revised SEIS, Reclamation ignores the true need and purpose for the revised guidelines. Reclamation again defaulted to the states as it did in 2007 and 2019 -- opting to obfuscate basin-wide accounting with the aid of taxpayer funds, questionable accounting mechanisms like ICS, and myopic inputs in the modeling. By buffeting paper water schemes with paper dollars, Reclamation has failed to fulfill its duties to defend public interest considerations inherent within the Colorado River Basin. What we observe is that Reclamation and the states are not motivated by public interest responsibilities. We cannot see how this deal even meets the minimal requirements of the 2006 Decree in the landmark Supreme Court case Arizona vs California.	Reclamation recognizes that the hydrology has declined since the modeling was redone based on June 2023 numbers, but it is still within the range shown in the graph from the Final SEIS Dear Reader Letter. As explained in the Dear Reader Letter to the Revised Draft SEIS, Reclamation analyzed the Lower Division Proposal (now the Proposed Action) at the request of the Seven Basin States, and that analysis shows that the Proposed Action balances the risk between Lake Mead and Lake Powell better than the alternatives considered in the Original Draft SEIS. The current range of alternatives thus meets the purpose and need to address low reservoir conditions across the Basin in the short term and, perhaps more importantly, provides the space "so that all parties can focus their resources on the development of the post-2026 guidelines" as described by the Seven Basin States.
310	21	POLICY - Policy and Legal Compliance	Reclamation must operate Glen Canyon Dam for the health of the Grand Canyon. As Reclamation determines how much water it will annually release through Glen Canyon Dam, the agency should release water in a way that mimics a historically-timed hydrograph. On other rivers where dams have been operated to mimic the historic hydrograph, benefits extended to a multitude of aquatic and riparian resources (Richter et al. 2003, Rood et al. 2003). Evidence is accruing that the same would be true for Grand Canyon (Healy et al. 2020, Healy et al. 2022). Beneficial flows are required under the Grand Canyon Protection Act and flows for ecological improvement such as High Flow Experiments (HFEs) have been successfully implemented without affecting the total amount of water released to the Lower Basin. Reclamation acknowledges that, to comply with the National Environmental Policy Act of 1969 (NEPA), "As stored water is released from the reservoir, it must be released consistent with the specific physical and operational characteristics of the release structures and the river below, which can include maximum and minimum flow rates; ...[or] considerations to meet ecological conditions, such as the time of year or temperature when water is released..." (RDSEIS p.1-9). However, flow timing is not considered in the RDSEIS. It must be analyzed in order to meet the requirements of NEPA, the Endangered Species Act, and the Grand Canyon Protection Act. Recommendation 1: The Near-Term Colorado River Operations (2024-2026) should require flows to be released from Glen Canyon Dam in a way that minimizes daily fluctuations, creates flood pulses in the spring when sediment levels are adequate (similar to pre-dam flood pulse timing), optimizes sediment retention downstream, and keeps water temperatures in the Colorado River through Grand Canyon at temperatures that scientists say are best to preserve native fish and wildlife.	This action concerns annual releases from Glen Canyon Dam as addressed under the Guidelines and other authorities that are part of the law of the river. The timing of when those annual volumes are released on a subannual level (hourly, daily, monthly) is addressed elsewhere under LTEMP pursuant to the Grand Canyon Protection Act and other appropriate authorities. We encourage comment in the EIS process associated with LTEMP, which will address, among other things, resource conditions in the Grand Canyon, including for fish species and sediment.
322	3	POLICY - Policy and Legal Compliance	Furthermore, while the Arizona Agencies generally support the proposed releases from Glen Canyon Dam as described in the Proposed Action for 2024-2026 operations. The Arizona Agencies do not waive any argument related to protection elevations at Glen Canyon Dam, the propriety of protecting such elevations, and any associated Colorado River Compact compliance related issues that may arise through reduced releases from Glen Canyon Dam. Certainly, the Arizona Agencies expect the Secretary to comply with and enforce the 1922 Colorado River Compact.	Thank you for your comment.

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324	2	POLICY - Policy and Legal Compliance	NAR recognizes the fact that water rights are property rights and must be honored. Water rights are essential because they establish the legal framework for water allocation, facilitate economic growth, protect the environment, and promote long-term stability. They provide a foundation for managing and preserving water resources and ensuring its availability for present and future generations. The concept of water rights traces back to the doctrine of prior appropriation, which governs water allocation in many western states. This doctrine establishes a system where the first person or entity to use water for a beneficial purpose obtains the right to continue using it, known as "first in time, first in right." This legal framework provides a basis for regulating water allocation and resolving conflicts over water use. NAR believes that if water rights are taken as a result of any of the RDSEIS options being implemented, that is a taking under the 5th Amendment of the U.S. Constitution, and the owner should receive just compensation for the taking.	Thank you for your comment.
340	1	POLICY - Policy and Legal Compliance	The Bands, along with their San Luis Rey Settlement partners, the City of Escondido and the Vista Irrigation District, depend upon 16,000 acre-feet of conserved Colorado River water from the lining of the All-American Canal and its Coachella Branch that is provided under the San Luis Rey Settlement Act. Pursuant to the San Luis Rey Settlement Act, as amended by Public Law 106-377, App. B., SS 211 (October 27, 2000): "Notwithstanding any other provision of law, in order to fulfill the trust responsibility to the Bands, the Secretary, acting through the Commissioner of Reclamation, shall permanently furnish annually ... 16,000 acre-feet of the [Colorado River] water conserved [by the lining projects] for the benefit of the Bands and the local entities in accordance with [the San Luis Rey Settlement]." (emphasis added). The SLRIWA previously submitted Comments on the Bureau of Reclamation's Notice of Intent to Prepare an Environmental Impact Statement and Notice to Solicit Comments and Hold Public Scoping Meetings on the Development of Post-2026 Operational Guidelines and Strategies for Lake Powell and Lake Mead on August 14, 2023. As set forth in those Comments and reiterated here, the 16,000 acre-feet of conserved Colorado River water provided under the San Luis Rey Settlement Act is not subject to mandatory reduction by Reclamation because that water has been permanently allocated for the benefit of the San Luis Rey Settlement parties in a Settlement approved by Congress, signed by the Secretary of the Interior and the Attorney General of the United States, and upheld in the United States District Court.	The risk of additional involuntary shortages is low, and Reclamation would not impose additional involuntary shortages without appropriate coordination and consultation. The analysis in the SEIS does not modify any entitlement or applicable statutory, settlement, or contract terms.

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370	2	POLICY - Policy and Legal Compliance	Due to the decline of Colorado River water, the Reclamation's Proposed Action for 2024-2026 has chosen the Lower Basin Proposal made by California, Arizona, and Nevada. The plan is to conserve an additional 3 million acre feet of water during this two year period. The Bureau proposes to use federal money from the Inflation Reduction Act to pay for 2/3 of the conserved water. This large reduction will greatly reduce the flow of fresh water into the Salton Sea. In addition to these proposed cuts, the Imperial Irrigation District announced on December 1, 2023 that they would conserve an additional 800,000 acre feet of water in 2024-2026. No wonder the Salton Sea is drying up so rapidly! Due to those proposed cuts, the flow of water to the Salton Sea will be at least 267,000 acre feet less during 2024-26. Reclamation may be justified in thinking that these reductions are necessary because of the lower flows in the Colorado river, but they must also start to recognize the need to find water to prevent the destruction of the Salton Sea. We cannot allow the Salton Sea to become a zone of sacrifice when it can be prevented. The Bureau has expressed that it doesn't matter if the proposed cuts will cause the Salton Sea to go down more quickly, because the damage done by the QSA water transfers will eventually kill the sea anyway. This is like saying that it doesn't matter if a husband person murders his wife, because she would die eventually anyway! This is completely insane!	Identification of new water sources for the Salton Sea is outside the scope of this SEIS. A comprehensive analysis of effects at the Salton Sea is currently in progress through distinct National Environmental Policy Act (NEPA) processes. These processes include the U.S. Army Corps of Engineers - Salton Sea Management Program (SSMP) Phase 1: 10-Year Plan (2018-2028) and the IID SEIS system conservation actions. Actions considered in this SEIS are not the main drivers of change in Salton Sea exposed lakebed. There are many sources of dust emissions in the Imperial Valley, and Reclamation acknowledges that the Salton Sea is one of them. This SEIS is analyzing a short timeframe of the remainder of the interim period, through 2026. Further, the total amount of lakebed exposure does not vary between the No Action Alternative and the Proposed Action in this SEIS. The SEIS Proposed Action and the No Action Alternative would result in the same level of lakebed exposure; the alternatives only vary in the rate of exposure.
370	5	POLICY - Policy and Legal Compliance	Article 1 of the Colorado River Compact of 1922 states that the purpose of the Compact is to insure "equitable division and apportionment of the use of the Colorado River system." However, the discussion, being undertaken by the Bureau of Reclamation to come to a new river Compact, has disregarded the inequity of denying a critical water supply to the Salton Sea. The federal government must live up to its legal obligation to avoid harm to the environment, wildlife and human life under the National Environmental Policy Act (NEPA.) The only way to restore the Salton Sea is to import ocean water from the Sea of Cortez or the Pacific Ocean. This ocean water can be desalinated and made into potable water. This will guarantee a supply of fresh water to the Salton Sea that will be independent of the Colorado River and climate change. Restoring the Salton Sea will have beneficial effects on the whole environment of the drier and hotter Southwest. In this way federal water managers can equitably distribute the water from the Colorado river, restore the Salton Sea, and enhance the quality of life in the region. P.S. The Arizona Department of Water has already completed a feasibility study of importing desalinated ocean water from the Sea of Cortez. This study was completed by the reputable engineering firm Black & Vetch. Their estimated costs for a dual pipeline were twelve times lower than the discredited UC Santa Cruz study of ocean water importation commissioned by the California Natural Resources Agency in 2022.	This comment is outside the scope of this SEIS. The SEIS only considers annual operations at Lakes Powell and Mead. The Post-2026 EIS is a good opportunity to review these suggestions.

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410	4	POLICY - Policy and Legal Compliance	In order to appreciate the potential impact of the Revised DSEIS on the Nation and its water rights, it is important to understand the historical context for the Nation's use, and the non-Indian impacts on, these rights. The Nation has one of the largest reservations in the United States, with over 35,000 members and multiple reservation land bases, mainly in southern Arizona, totaling nearly three million acres of land. Climate change and drought have exacerbated the damage caused by centuries of federal mismanagement of tribal water rights, and the failure by the federal government to protect against non-Indian damage to these rights. The Nation's members (the Tohono O'odham) and their ancestors have cultivated this land since time immemorial, growing all manner of crops to support their way of life. Writing in the mid-19th century, a former superintendent of Indian Affairs for the Arizona Territory noted: "The [Tohono O'odham] inhabit that triangular space of arid land bounded by the Santa Cruz, Gila and Colorado rivers, and the Mexican boundary line." ". . .and here they have lived and planted and watched their flocks and herds ever since. . ." "They raise wheat, corn, barley, beans, peas, melons, and pumpkins, and are experts in the manufacture of pottery and willow-ware. In harvest time they spread all over the country as reapers and gleaners, returning with their wages of grain for winter." "They have horses, cattle, sheep, poultry, and a great number of dogs." "As these Indians were found in possession of the soil, they cultivate and have maintained themselves there continuously ever since, it would seem equitable that their rights should be recognized by the Government of the United States."2 A later visitor noted that "where floods occurred, the water spread out in a thin sheet over the valley" in the Tohono O'odham homelands, "doing no damage."3 These same reports noted that "[a]s late as 1873 the valley was covered with grass."4 In the late 19th century, a U.S. Indian Agent described the Nation's San Xavier Reservation as: [N]aturally more valuable than any other piece of land I have seen in the [Arizona Territory], because the water of the Santa Cruz River rises to the surface and flows almost 2 miles before leaving the Indian land. Here is also fully a thousand acres of the finest grazing land and more than seven thousand acres of the largest mesquite timber in the territory.5 Throughout the late 19th and into the 20th centuries, encouraged by the federal government, the Tohono O'odham improved and expanded their existing cultivation at San Xavier and developed thousands of additional acres of farmland in the northern portion of the Main Reservation in the Sif Oidak District.6 During the same period, however, non-Indian settlement and water use drastically undermined the Nation's use of its water rights. This damage was further exacerbated by decades of inaction and mismanagement by the federal government, and by the encouragement of off reservation irrigation through Reclamation loans and low cost preference-rate federal power, representing a comprehensive and profound failure on the part of the Nation's trustee to protect its water rights. East of the Nation's Main and San Xavier Reservations, mining, irrigation, and the growth of the nearby City of Tucson created "a serious imbalance between existing supply and demand" resulting in "significant, long term declines in local groundwater levels."	Thank you for your comment.

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410	5	POLICY - Policy and Legal Compliance	By 1975, the surface flow of the Santa Cruz River disappeared. Except for a few small Mesquite, the forest of trees vanished; and due to the lack of water all farming, except for 800 acres [was] destroyed. The damage to the Nation's reservation and water supply ultimately led the Nation and the United States on the Nation's behalf to file suit against major water users. Meanwhile, similar actions by non-Indians along the northern boundary of the Nation's Main Reservation depleted the water table within the Sif Oidak District to a point where many of the existing wells went dry and irrigation had to be abandoned. The Nation settled a portion of the substantial water rights claims concerning the eastern portion of its reservation lands through the Southern Arizona Water Rights Settlement Act, Pub. L. 97-293 (1982) (SAWRSA), as amended by the Arizona Water Settlements Act, Pub. L. 108-451 (2004) (AWSA). Under SAWRSA, the Nation gave up its significant claims concerning damages to groundwater and surface water in the Tucson Active Management Area. In exchange for releasing these claims, the United States promised that the Nation would receive reliable, affordable, and long-term access to CAP water. The federal government promised to safeguard the delivery of this entitlement through two separate mechanisms. First, the Secretary must deliver the Nation's entitlement from the CAP "or an equivalent quantity of water from any appropriate source notwithstanding any declaration of shortage or other occurrence affecting water delivery caused by an act or omission of the federal government and its agents." In the event that the Secretary is unable to meet this obligation, she must compensate the Nation for this failure. Second, the Secretary must, pursuant to Section 105 of AWSA, firm 28,200 acre-feet per year of the Nation's Non-Indian Agricultural priority water such that this water is delivered during water shortages in the same manner as water with a municipal and industrial delivery priority in the Central Arizona Project system is delivered during water shortages. Congress vested Interior with the responsibility to manage and fund delivery of the Nation's CAP entitlement, and authorized substantial federal funding to pay for these deliveries. However, Interior has historically failed to seek adequate appropriations to fund this settlement, threatening access to the Nation's CAP water.	The risk of additional involuntary shortages is low, and Reclamation would not impose additional involuntary shortages without appropriate coordination and consultation. The analysis in the SEIS does not modify any entitlement or applicable statutory, settlement, or contract terms.
410	6	POLICY - Policy and Legal Compliance	Reclamation must account for settled and unsettled Tribal water rights in analyzing the Revised Draft SEIS. As confirmed by federal court decisions, as well as Reclamation's own internal guidance, the federal government's trust responsibility extends to the protection of tribal water rights, irrespective of other competing claims to water.15 The overarching lens through which Reclamation views impacts to the Nation and other federally recognized Indian Tribes is what it refers to as "Indian Trust Assets" (ITAs) namely, "assets held in trust by the federal government for the benefit of Native American Tribes or individuals" 16 and as "environmental justice populations"17 According to Reclamation's NEPA Handbook: Reclamation is committed to carrying out its activities in a manner that avoids adverse impacts to ITAs, when possible, and mitigates or compensates for such impacts when it cannot avoid the impacts. All impacts to trust assets, even those considered nonsignificant, must be discussed in the trust analyses in NEPA documents and appropriate compensation or mitigation implemented.18 Indian Trust Assets analyzed for the purposes of the DSEIS derived from the Final Environmental Impact Statement for 2007 Interim Guidelines (2007 FEIS),	Thank you for your comment. Reclamation prepared this SEIS to analyze the potential environmental effects of the proposed action. Section 3.7 of the SEIS analyzes impacts to water deliveries. As described in Section 3.3, a Shortage Allocation Model was used in addition to the CRMMS to analyze the potential impacts of the alternatives on individual water users including tribes within each Lower Division State. The SEIS further analyzes Indian Trust Assets in Section 3.18 and quantified water rights. The Shortage Allocation Model, however, does not account for the existence of external arrangements and commitments that would affect alternate water availability to these tribes or the ultimate impacts of water unavailability to an entitlement. Reclamation will continue to work with the Nation to ensure water delivery consistent with the Nation's water rights settlement through a separate process. The risk of additional involuntary shortages is low, and Reclamation would not impose additional involuntary shortages without appropriate coordination and consultation. The analysis in the SEIS does not modify any water entitlement or applicable statutory, settlement, or contract terms.

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410 *(cont.)*	6 *(cont.)*	POLICY - Policy and Legal Compliance *(cont.)*	and included "federal reserved Indian rights to Colorado River water including rights established pursuant to Arizona v. California, Colorado River water Tribal delivery contracts where such contracts are part of a congressional approved water rights settlement; and Indian reservations."19 As the NEPA Handbook acknowledges, all impacts to trust assets, even those that Reclamation may consider "nonsignificant" must be discussed in the DSEIS, and "appropriate compensation and mitigation implemented."20 In addition to examining impacts to trust assets, Reclamation must prioritize the protection of these assets. Courts have repeatedly held and affirmed the priority that federally reserved water rights have over competing water rights.21 While Congress may sometimes require the federal government to "carry water on at least two shoulders" in representing both tribes and nontribal interests,22 "the government remains under a firm obligation to represent [a Tribe's] interests forcefully despite its other representative obligations," and its failure in this regard may constitute a breach of its trust obligation.23 Unfortunately, like the now-withdrawn DSEIS, the Revised Draft SEIS employs flawed methodology to catalogue ITAs and to analyze potential impacts resulting from the alternatives on Tribes, appropriate "compensation or mitigation," and environmental justice impacts. First, while the Nation's SAWRSA settlement is included as an ITA, the Revised DSEIS does not account for or address Reclamation's responsibilities to ensure the full delivery of the Nation's entitlement in times of shortage, or compensation to the Nation in the event that such deliveries are not carried out. Second, while ITAs include "Indian reservations," the DSEIS does not appear to assess the impact of the action alternatives on unquantified Winters rights24 on Indian reservations that are not immediately adjacent to the Colorado River. Nevertheless, the Revised DSEIS, as proposed, promises to have an ameliorative impact on the Nation's trust assets in comparison to the No Action Alternative or the action alternatives in the now-withdrawn DSEIS. As the Nation discussed in its pre-scoping comments,25 however, the Nation and other Tribes lacked a seat at the table producing this proposal. It is therefore incumbent on Reclamation, in fulfilment of its trust responsibility to Tribes, to prioritize tribal interests in finalizing the SEIS. It is also incumbent on Reclamation, in finalizing the SEIS, to rectify the errors in its now-withdrawn DSEIS and Revised Draft SEIS. A. The Revised DSEIS must adequately address impacts to the Nation's water rights settlement. On the whole, the conservation measures in the Proposed Action appear to address the most significant concerns with the action alternatives in the now-withdrawn DSEIS. By foregoing additional reductions, the Proposed Action avoids setting up the kind of collision course between shortages and the Secretary's SAWRSA delivery obligations contemplated under that the DSEIS action alternatives. Still, as discussed above, Interior has long failed to adequately fund CAP deliveries under the Nation's SAWRSA water settlement, and Reclamation modeling predicts significant future strains on these deliveries, with or without the imposition of additional reductions contemplated under the original DSEIS action alternatives. The 2007 FEIS explicitly included the Nation's SAWRSA settlement as an ITA, and the Revised DSEIS incorporated this inclusion.26 Through the Nation's SAWRSA settlement, the Nation obtained a substantial CAP entitlement in return for releasing claims concerning	Reclamation continues to work on settling tribal water rights. Reclamation is committed to the discussion of tribal water with individual tribes that is beyond the short timeframe covered by this SEIS. Consultation is ongoing.

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410 *(cont.)*	6 *(cont.)*	POLICY - Policy and Legal Compliance *(cont.)*	damages to its federal reserved rights. Yet the Revised DSEIS does not discuss how the Secretary plans to carry out her obligation to deliver this water notwithstanding a declaration of shortage, nor how the Secretary will provide compensation in the event that she is unable to fulfil this obligation. Instead, as detailed in Appendix E, the Revised DSEIS appears to assume that the Secretary will simply not deliver this water to the Nation. Nor does the Revised DSEIS provide any analysis or discussion of the impact of the reductions on its firming obligation under AWSA - an obligation which Reclamation repeatedly has acknowledged requires the Secretary to identify and secure significant resources and alternative water supplies, and one that Reclamation must carry out for 100 years from the effective date of AWSA (i.e., through the year 2107). Reclamation repeatedly has acknowledged that firming requires the Secretary to identify and secure significant resources and alternative water supplies. Unfortunately, throughout the Interim Guidelines period, rather than taking a proactive approach to secure these resources in non-shortage years, Reclamation largely ceded control to non-Indian interests, thus exacerbating the impact, during shortage years, of shortages on the Nation. A key example is Reclamation's dispute with the Central Arizona Water Conservation District (CAWCD) over Central Arizona Project Excess Water.27 Reclamation's 2007 Stipulation with CAWCD over CAP repayment provides Reclamation with a priority right to purchase Excess Water, which Reclamation may then subsequently store for Indian firming - a right that Reclamation describes as a "critical resource for meeting the federal firming obligation."28 In violation of the stipulation, CAWCD instead diverted Excess Water for non-Indian programs, resulting in a loss to Reclamation's firming program of tens of thousands of acre-feet.29 But apart from a series of strongly-worded emails, letters, and comments submitted to the Arizona State Auditor, it is unclear whether Reclamation has taken formal action to recover these lost resources. The Revised DSEIS notes that the failure to deliver water could result in revenue losses to the Nation, but does not address this impact other than to merely state in its environmental justice section, without any further discussion, that it is "important to note that losses in revenue are impacted by other factors, including, but not limited to, the implementation of water rights settlements and availability of other resources."30 Elsewhere, the impacts of the reductions to the Nation's and other Tribes' allocations are addressed through a single, fine-print footnote: Note: This preliminary analysis attributes shortage to the base allocation or entitlement according to its priority. The ultimate impacts, both financial and in terms of the lost productive value of water, are diverse according to their varied uses and compensation structures under a large body of exchanges, leases, and other federal and non-federal arrangements and commitments. This distribution of shortage to the base allocation only provides the initial necessary information to assess impacts in detail as part of administering	*(See above.)*

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484	2	POLICY - Policy and Legal Compliance	Appropriately, the Revised Draft SEIS does not analyze the entire Colorado River System, but instead only focuses on addressing the low-runoff and low-reservoir conditions at Lake Powell and Lake Mead. The Proposed Action Alternative focuses primarily on additional Lower Basin use reductions, adopting the system conservation option put forward in the Lower Division Proposal. 1 [See footnote in comment letter] Under the Lower Division Proposal, the Lower Division States represent that they will reduce use by an additional 3.0 maf by the end of 2026, above and beyond the reductions and contributions required by the 2007 Interim Guidelines and the Lower Basin DCP. According to the language of the Lower Division Proposal, these additional reductions are to be "mandatory, enforceable, measurable, verifiable, and nonretrievable." However, the Revised Draft SEIS does not require mandatory or enforceable reductions. On the contrary, the Revised Draft SEIS explicitly acknowledges that the proposed reductions are not enforceable.2 [See footnote in comment letter]. Further, not all the system conservation agreements considered in the Revised Draft SEIS have been fully executed, including agreements for conservation in 2024. As a result, the Proposed Action Alternative relies on speculative reductions which, even if the anticipated agreements are executed, cannot be legally enforced to produce the conservation modeled in the Proposed Action Alternative. Reclamation must ensure that the SEIS conservation is mandatory and enforceable, as represented in the Lower Division Proposal, so that the Proposed Action Alternative can achieve the purpose and need identified in the Revised Draft SEIS.	The reductions are not speculative. Conservation agreements have either been executed or are reasonably foreseeable. As of December 2023, Reclamation has executed contracts for approximately 1.55 million acre-feet of system conservation water, and is actively working on additional system conservation agreements to be signed in 2024 which could add approximately 800,000 acre-feet through 2026. The Lower Division States and their partners may also enter agreements to implement SEIS conservation and need to be given this flexibility. For example, the Lower Division States have targeted approximately 600,000 additional acre-feet of conserved water in 2023 that would count as SEIS conservation as described in the DSEIS. Reclamation has a strong partnership with the seven Basin States, water users, tribes, and Mexico, and we expect that to continue. This partnership has, among other things, resulted in conservation activities that have added approximately 5.1 million acre-feet to Lake Mead between 2007 and 2022. These types of agreements and partnerships have been effective and Reclamation will continue to utilize them to meet water conservation targets for the duration of the interim period.
484	5	POLICY - Policy and Legal Compliance	The Revised Draft SEIS states that "[t]he Secretary reserves the right to operate Reclamation facilities to protect the Colorado River system if hydrologic conditions require such action." This reservation is overly broad and undefined.	The Secretary retains broad authorities to protect the integrity and operations of federally owned facilities and infrastructure that Congress has authorized as critical components of water development across the entire Basin. No change has been made to the document.
539	4	POLICY - Policy and Legal Compliance	Law of the River The District, and other water users on the River, have come to rely on the Law of the River and the Bureau's commitment to it and the water delivery contracts signed by the United States many decades ago. A key tenet of the Law of the River is the priority system. Users have acted in line with and have placed enormous reliance on the system and the whole of the Law of the River for almost a century. Proper application of the priority system is vital. As a result, implementation of any operational guidelines developed through the revised draft SEIS, and any additional actions taken by the Basin States or Reclamation under the emergency clause of the proposed action must certainly follow and comply with the Law of the River.	Noted.
548	1	POLICY - Policy and Legal Compliance	GENERAL COMMENT: As described, the No Action and Proposed Action alternatives do not meet Reclamation's statutory mandate in Section 7 of the CRSP Act of 1956 that the Glen Canyon Dam hydropower plant "be operated in conjunction with other federal powerplants, present and potential, so as to produce the greatest practicable amount of power and energy that can be sold at firm power and energy rates". (emphasis added). As Commissioner Touton testified before Congress on April 26, 2023 "Reclamation's projects and programs serve the water and power infrastructure backbone of the American West...".	The No Action alternative is a NEPA requirement that does not need to meet the purpose and need statement, which is why the SEIS process began. The Proposed Action does meet the purpose and need to modify guidelines for operation of the Glen Canyon and Hoover Dams to address historic drought, historically low reservoirs, and low-runoff conditions as it reduces the risk of Lake Powell and Lake Mead reaching critically low elevations, which could impact operations during the interim period. For purposes of hydropower production at Lake Powell, such critical elevations at Glen Canyon Dam preserve the option for hydropower generation for the CRSP system, and preserve hydropower generation options at Hoover Dam.

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550	3	POLICY - Policy and Legal Compliance	3. We also recommend that the Bureau institute a formal, regularly scheduled consultation process with state governments, Tribes, and Mexico to determine if midcourse corrections to models and operating guidelines will be required based on actual hydrological conditions and conservation measures.	Noted.
283	2	POST2026 - Post 2026 Guidelines	In closing, GCRG would like to refer you to our previously submitted official comments, as there is significant overlap for this SEIS: * GCRG scoping comments for the Post-2026 Operational Guidelines and Strategies for Lake Powell and Lake Mead * GCRG scoping comments on SEIS for the Glen Canyon Dam Long Term Experimental and Management Plan * GCRG comments on the Smallmouth Bass Flow Options EA	Thank you for your comment.
290	1	POST2026 - Post 2026 Guidelines	Based on "Revised Draft Supplemental Environmental Impact Statement" it is obvious that Bureau of Reclamation (BoR) ignored my comments submitted on August 15, 2023. Also, BoR ignored numerous comments from public and knowledge expert that I heard during previous Zoom meetings and seeing some of written public comment pointing out on incoming ecological disaster if we continue with "current course of action" and lose the Salton Sea. Including the Salton Sea for the Development of Post-2026 Operational Guidelines and Strategies is very important issue because the Salton Sea is a part of the Colorado River Basen and is facing incoming environmental disaster with toxic dust storms and subsequent liability related to serious consequences to the public health, and economy in general. The BoR must be aware of the disconnect between agencies and manipulative and illegal conducts of some participant (influential stakeholder) by 'sabotaging' certain proposals to achieve their goal (pushing forward their proposal) which is getting rid of the Salton Sea for their pitiful interest. The main reason for such behavior is a combination of incompetence and short-sightedness, greed, and lack of concern for the environment, the health of nearby population, and economy in general. I respectfully urge BoR, again, to reconsider its decision and include the Salton Seas, - not just in "Post-2026 Operation", - but to enforce its own policy and in cooperation with CNRA and Army Corps of Engineers open investigation and work on speedy evaluation of my proposal for the restoration of the Salton Sea.	Thank you for your comment. The Bureau of Reclamation is actively supporting Salton Sea Restoration efforts, including with the US Army Corps of Engineers and the State of California. While management of the Salton Sea is not within the scope of this SEIS, the Salton Sea was assessed in this Final SEIS under cumulative impacts.
295	4	POST2026 - Post 2026 Guidelines	An opportunity to make the needed 2-4M AFY in cuts through the SEIS process has been effectively deferred until post-2026 operations because of one above-average precipitation year in the Colorado River Basin: a short-sighted approach that will make the post-2026 cuts that much more challenging. In an ideal world, major cuts in water use would be phased in over a decade or more, with accommodations and adjustments made at a manageable pace. But the opportunity for gradual adjustments has passed, and a soft landing for every impacted water user may not be obtainable. Also, there is an urgent need for equitable cuts that involve both agriculture and urban users.	Action Alternatives 1 and 2 were considered in the original Draft SEIS but were ultimately dismissed from detailed analysis in the revised Draft SEIS because their performance was similar to or worse than the Lower Division proposal (now the Proposed Action) as explained in the Dear Reader Letter to the Revised Draft SEIS and Section 2.8. Reclamation analyzed the Lower Division Proposal (now the Proposed Action) at the request of the Seven Basin States, and that analysis shows that the Proposed Action balances the risk between Lake Mead and Lake Powell better than the alternatives considered in the Original Draft SEIS. The current range of alternatives thus meets the purpose and need to address low reservoir conditions across the Basin in the short term and, perhaps more importantly, provides the space “so that all parties can focus their resources on the development of the post-2026 guidelines” as described by the Seven Basin States.
314	4	POST2026 - Post 2026 Guidelines	while we understand the limitations in geographic scope for near-term operations, it will be of utmost importance that long-term operation planning includes impacts to the entire Colorado River Basin and the 4,400 miles of whitewater boating that exist in the geographic basin boundary.	Thank you for your comment.

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539	9	POST2026 - Post 2026 Guidelines	Post-2026 Precedent Nothing in this SEIS process or the Record of Decision should inform or create precedent for the post-2026 guidelines. The full EIS process required by the development of post-2026 guidelines should be separate and distinct in its analysis and proposed outcomes.	Reclamation has stated that development of post-2026 guidelines is a separate process.
282	1	POWER - Electrical Power	Comment 1: Page 3-10 to 3-11 Cumulative Impacts Cumulative impacts are insufficiently identified and considered for the hydropower resource. One of the most important results that we see from this proposed action is that to keep from going below MPP the reservoir will likely remain lower in elevation (without dropping below MPP) which is good for power directly, however because of the Smallmouth Bass issue, it may result in the reservoir remaining, on average, in a cautionary zone below about 3575 where bypass is likely under BORs proposed cool mix bypass option. Keeping elevations above MPP creates value in this analysis, but that could then put the reservoir in just the wrong elevation range to result in required bypass under the LTEMP SEIS. This is a critically important concept that should be evaluated and discussed as a cumulative impact and potentially would negate any potential hydropower benefit described. For example, if you keep elevations just above MPP to avoid going below and reduce flows, that would result in a positive economic value in this analysis. However, given what is likely under the LTEMP SEIS that would be below 3575 and have a very high likelihood of requiring substantial bypass amounts for SMB, and thus for hydropower it might be as if going below MPP. The only way around this that seems reasonable is an alternative that keeps summer elevations above 3575 and from analyses that WAPA has done on the initial hydrologic data from BOR would eliminate about 90% of the instances of needed bypass for SMB as triggered by temperatures at the LCR.	The cumulative impacts sections have been updated to better address the cumulative effects of this SEIS along with the LTEMP SEIS.
282	2	POWER - Electrical Power	Comment 2: Page 3-272 Suggest removing the following paragraph as it is not accurate. We do not have a suggested re-write at this time as we are still working to determine what the requirement would be for regulation and reserves: Remove At Glen Canyon Dam, flows are required to be approximately 1,0002,000 cfs above the minimum flows, as outlined in the LTEMP, for ancillary services to continue. As a result, flows must be 9,00010,000 cfs during the daytime and 6,0007,000 cfs at nighttime to reliably support ancillary services. The Glen Canyon Powerplant typically holds approximately 40 MW in regulation.	Removed text per comment.
282	3	POWER - Electrical Power	Comment 3: Page 2-249, The last paragraph under Surcharges and Ancillary Services needs to be revised as it combines various services between Glen Canyon and Hoover, and the language is difficult to understand what the intended meaning actually is. The sentence Reserves are used to is the only sentence we would recommend leaving in of that paragraph that continues into the next page.	Updated text per the comment.

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282	6	POWER - Electrical Power	Comment 6: General A critical analysis that should be added is a better description of how the alternatives would or would not result in bypass by going below MPP and how that affects hydropower. The reason is because that is the primary driver of economic value and downstream impacts, yet being either above or below MPP is a condition that appears lost in the data. There is some treatment of this in Section 3.6 and in Figure 3-6 as a percentage, but what would be helpful is to see the number of instances per year of going below MPP and the amount of bypass volume by year.	This information can be found in Section 3.15. However, additional details and references to previous figures have been added to make it clear which alternatives have the higher likelihood of dropping below minimum power pool. Reclamation is using the best available science and some of the data requested is not available.
290	24	POWER - Electrical Power	5.6 The same applies for those that promote three proposed geothermal projects for the extraction of lithium from geothermal brine (the Black Rock Geothermal Projects, Morton Bay Geothermal project, and Elmore North Geothermal, an indirect, wholly owned subsidiary of BHE Renewables, LLC.). 5.6.1 NOTE: During writing this letter, came to my attention the response by Jacobs to CEC's inquiry titled: " Black Rock Geothermal Project Air Quality Operational Emissions Spreadsheet " Docket Number 23-AFC-03 - Bleck Rock Geothermal Project (BRGP). The document is a spread sheet with information (data) about "Project Emission Summary" etc. I have seen quite a few similar documents earlier about air monitoring stations, efficiency of cooling tower, etc., trying to prove validity of their project. I am using this opportunity to comment on that issue because it is relevant to the overall gray situation of the Salton Sea and the disconnect between agencies (CNRA, CalEPA, CEC, BoR) which I mention in segment 4.1 and 4.3 above. 5.6.2 NOTE: The applicants of those three geothermal projects are focused on their particular projects and they are not concerned about overall situation of the Salton Sea because they might not be fully aware of the existence of the master plan (architectural plan) for the restoration of the Salton Sea because my concept has not been officially accepted yet, and because they are not in business of taking care of Salton Sea nor the environment. There are in business of getting certificate from the CEC and making money from geothermal projects. That is another strong reason for the State to speed up evaluation of my proposal and provide condition for proper development of the situation around the Salton Sea that includes the restoration of the Salton Sea, synchronization of mentioned geothermal project to fit into master plan, and implementation of States policies regarding environment, energy, and wellbeing of the population. 5.6.3 NOTE: Without going into specifics of those several responses by applicants that I have seen, the data presented is from "Modeling Emission Summary" provided from an obsolete system. Also, as presented, those geothermal projects are not in harmony with the long-term plan (master plan) for the restoration of the Salton Sea. Making colorful diagrams with estimates (predictions) of the water level, salinity level, air quality, and algae, etc., will be in 10, 20, or 50 years does not contribute at all to the restoration of the Salton Sea. 5.6.4 NOTE: It is important to understand that by building a dike around the edge of their preferred location (lot(s)), as I explained and illustrated in my architectural plan (proposal), means that they would be able to continue with their "obsolete" systems without destroying the Salton Sea. Preferably those three applicants could work with me (consult with me) and accept my "patented" system that uses a completely closed-loop system, - both, for cooling system (without cooling towers that requires a substantial amount of water) and for production of	This is out of scope of this SEIS.

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290 *(cont.)*	24 *(cont.)*	POWER - Electrical Power *(cont.)*	potable water and concentrated brine - that are superior to conventional systems. 5.6.5 Also, it is important to clarify that the applicants had provided several faulty information in order to boost support for their projects such as the number of households that they will provide power to. For example, applicants stated on several occasions that 1 MW of generated electricity would provide power for about 700 households. The more realistic number is about 250 - 300 households. 5.6.6 Also, the applicants stated on several occasions that they relied on a promise by the IID to supply the necessary water that they need for the functioning of their proposed geothermal plants for the extraction of lithium. 5.6.6.1 NOTE: The IID cannot supply water that does not have. Unless it is openly disclosed that allocated water (promised water) is at the expense of the dying Salton Sea. The nearby population, including tribes, needs to understand that. So far that has not been voiced. That is my assertion that I am repeating frequently and requesting the straight answer. Unfortunately, I have been ignored so far. That is another reason for the top state officials to act with a proper evaluation of my proposal. 5.6.6.2 NOTE: Because of drought and restriction of water from Colorado River, with the "current course of action" we do not have enough water neither for balancing evaporation of the Salton Sea nor for managing exposed lakebed of the shrinking Salton Sea. The "current course of action" leads to destruction of the Salton Sea. That is my assertion that I am repeating frequently. I respectfully urge commissioners of the CEC to pose those questions and request a solid answer. Such critical information should not be ignored or hidden from the population. Unfortunately, so far that is the case. 5.6.7 In one televised meeting, the applicants mentioned that they intend to use "their" system for recycling water, therefore, they will need less water but did not disclose technology for proprietary reasons. In such case the members of the CEC should have access to verify the uniqueness of such technology and check on available patents and priority dates. I am saying that because I have been proposing for quite a few years about using "closed-loop environmental" system for generation of potable water in geothermal power plants that could be very useful for providing (increasing concentration) concentrated brine that can be used for extraction of lithium regardless of specific technology that can be implemented for the extraction of lithium from geothermal brine. 5.6.8 NOTE: In order to make right decisions, it is important that the BoR, Wade Crowfoot, Secretary of CNRA, Governor Gavin Newsom, Yana Garcia, Secretary of CalEPA, and especially David Hochschild - chair of the California Energy Commission knows that the applicants of three geothermal projects (Black Rock Geothermal Projects, Morton Bay Geothermal project, and Elmore North Geothermal, an indirect, wholly owned subsidiary of BHE Renewables, LLC.) are aware of the existence of my proposal for the restoration of the Salton Sea. I sent my introductory letter with links to my proposal to Ms. Christina Fleming, VP of Mineral Development for BHER, on July 18, 2023, and a letter to Mr. Rob Berntsen, Senior Vice President and General Counsel, BHE Infrastructure Group, on September 3, 2023, and a letter to Mr. Jon Trujillo, GM Geothermal Development, BHE Renewables on October 5, 2023. Also, I did mention the existence of my proposal and summarized it in a few minutes in my public comment during televised meeting in High School in Calipatria where representatives of BHE Renewables, LLC., were present on	*(See above.)*

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290 *(cont.)*	24 *(cont.)*	POWER - Electrical Power *(cont.)*	August 31, 2023. In my introductory letters, I offered them cooperation and suggested to them to extend their involvement in restoration of the Salton Sea beyond just geothermal projects. I have not received any response from them yet. Obviously, they are not in a position, as applicants, to make radical changes in their primary mission, which is not the restoration of the Salton Sea (see 5.6.2). Also, there is no incentive for them to be involved in the project unless my proposal is officially accepted by the State. That is another strong reason for the top state officials to initiate a speedy evaluation of my proposal and officially accept it as master plan to follow.	*(See above.)*
298	2	POWER - Electrical Power	One remaining area of concern is the potential impacts to hydropower. SRP recommends additional consideration of any cumulative impacts associated with this process, as well as other concurrent federal processes. Section 2.8.8 discusses the considered but eliminated Hydropower Prioritization Alternative and states that "the Proposed Action contemplates protection of critical reservoir levels and the continued resulting water deliveries that accordingly relate to the ability to generate hydropower." SRP is not suggesting an alternative that prioritizes hydropower over all other purposes; however, it is important to account for cumulative impacts to hydropower from other ongoing processes, such as those associated with Glen Canyon Dam Long-Term Experimental and Management Plan (LTEMP) SEIS6 SRP provided extensive comments to the LTEMP SEIS relating to the impact to the Phoenix metropolitan area if there were to be a reduction in available capacity from federal hydropower during times of peak need. At a minimum, SRP suggests consideration of the cumulative hydropower impacts associated with the LTEMP SEIS to account for the full range of possible outcomes in that process beyond the specific sub-annual water release parameters (base and experimental "flow actions") currently identified in the Revised Draft SEIS.	The cumulative impacts sections have been updated to better address the cumulative effects of this SEIS along with the LTEMP SEIS.

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306	27	POWER - Electrical Power	Pp. 3-241 et subseq.: Two concerns we have with hydroelectric power production impacts under low inflows in this document are as follows: First is the uncertainty and challenges imposed by using a 24-month modeling approach to managing flows. Relevant to this issue, Wang et al. (2022) state that "...the hydrology used in the 24 MS does not fully capture the risks of ongoing aridification of the Colorado River basin and that water-supply planning ought to better anticipate the risks of decreasing inflows to Lake Powell" and "... if the current 1991-2020 reference period does not adequately predict future conditions, we continue to risk overpredicting future Lake Powell elevations." Were flow management decisions made in April or May (rather than in autumn) and were flow projections made for one and a half, rather than two future years, the power industry could much more reliably understand both water availability and its ability to deliver hydropower. The major source of uncertainty in power marketing seems to be trying to project climate variability out to two years, whereas a 1.5-yr projection period seems to be far more accurate. Granted, this would entail major changes in power marketing, but using the existing modeling tools it would be easy and useful to know how such a shift would affect the reliability of water and power delivery and overall economics. Second, we recommend consideration of modeling flow release variation on an every-other-day, or every-third-day schedule. While such a dire situation is worth avoiding, such contingencies should be clearly understood prior to having to apply them. Also, there may be unforeseen economic and environmental advantages to such flow scenarios in relation to water conservation, shoreline stability, retention of fine sediments, etc. Granted, the imposition of such extreme measures may not be required in the short duration of flow management for this SEIS, but the planning and conduct of such scenarios is quite relevant to the longer-term management of river flows under human-caused global climate change.	The analysis included in this SEIS uses the best available science. By incorporating the 80% and 90% ESPs into the modeling effort, Reclamation has considered the potential for hotter and drier conditions associated with ongoing aridification. This SEIS does not consider flow durations under a monthly time step. Changes in releases on a daily basis is out of scope.
484	22	POWER - Electrical Power	Power Marketing Critical information is missing from this section, or other parts of the SEIS. The Colorado River Storage Project Act ("CRSP") resources are marketed under long term contract as an integrated project: changes at Glen Canyon Dam can also impact changes at Aspinall/Flaming Gorge, and vice versa. In regard to the "no changes" comment (Hydropower Generation section), while this is true of generation, the statement is not true of pricing. The CRSP rate design has changed significantly since 2007, due in large part to drought conditions and the need to maintain a stable Upper Colorado River Basin Fund. The CRSP firm electric service customers have taken on additional responsibility regarding replacement power, which clearly is impacted by changed operations of the CRSP generation resources.	This SEIS concerns annual release volumes from Glen Canyon Dam and does not propose changes to hydropower operations for the CRSP reservoir system across the Basin. The CRSP power units across the Basin and the need to maintain the Upper Colorado River Basin Fund are outside the scope of this SEIS. Reclamation recognizes that these components are interrelated. Appendix K of the Final LTEMP EIS analyzes environmental justice impacts and impacts on Tribal customers. Chapter 3 of the LTEMP EIS provides analysis of hydropower and marketing.

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548	9	POWER - Electrical Power	(3-254 through 3-256): Please include the relevant metric on each of the tables (MWh). The DSEIS should include impacts to the federal electric service rates, including but not limited to the CRSP rate. Some CRSP customers receive a "bill credit" intended to represent the federal resource benefit. When there is a change in the CRSP resource provided, those entities may receive a smaller (or larger) credit, meaning the federal benefit anticipated since 2004 may be different. The bill crediting benefit is one which each tribe can decide how best to use in its community. The rate impact to benefit crediting customers should be included in the Environmental Justice section of the DSEIS.	MWh were added to the table. This SEIS does not propose changes to hydropower operations for the CRSP reservoir system across the Basin. Specific effects related to these resource tradeoffs are being addressed in greater detail in the LTEMP SEIS because they are more closely related to subannual flow considerations described there versus the annual considerations described here.
548	12	POWER - Electrical Power	3.15 ELECTRICAL POWER RESOURCES/3.15.1 AFFECTED ENVIRONMENT (3-242): Recommend referring to the funds derived from the sales of federal power and transmission as "federal accounts" or specifically cite their statutory titles. Technical they are not "power funds". Also, along with the bulletized list of resources analyzed, the "electrical grid" should be added to the listing. Throughout the DSEIS there is mention that the "nature" of hydropower generation "hasn't changed since 2007". In referring to the method of generation since the 2007 Guidelines, that is a correct statement. However, since the 2007 Guidelines, the western grid has seen significant changes and challenges as utilities are transitioning to a more carbon-free future. In that endeavor, the total regional generation resources necessary to serve the needs of the Western Interconnection have significantly changed, often resulting in a near shortage of resources available to provide replacement power due to changed operations or experiments. Further, the nature of the resources has changed, with significantly more non-dispatchable resources entering the grid. The Western Interconnection provides reliable, essential electrical service to millions of people in the West. As changes are proposed for Glen Canyon Dam and Hoover Dam, two of the largest dispatchable hydropower resources in the West, impacts to the grid must be analyzed and mitigated. These conditions and concerns were not as prevalent during preparation of the 2007 Guidelines and must be addressed in any current NEPA process involving federal Colorado River generation and transmission resources. (3-243): This paragraph again refers to the "no changes since 2007" and refers to the LTEMP ROD as "regulations". CREDA recommends that the LTEMP be described as a ROD, and that reference also be made to the Flaming Gorge and Aspinall Unit RODs (both in place post-2007). As the CRSP resources are marketed under long term contract as an integrated project, changes at Glen Canyon Dam can also impact changes at Aspinall/Flaming Gorge, and vice versa. Finally, in regard to the "no changes" comment, the CRSP rate design has changed significantly since 2007, due in large part to drought conditions and the need to maintain a stable Upper Colorado River Basin Fund. In essence, the CRSP firm electric service customers have taken on additional responsibility regarding replacement power, which clearly IS impacted by changed operations of the CRSP generation resources. In the Power Marketing text, CREDA recommends revising "facilities" to "projects". WAPA's contracts with its customers are for project (statutorily authorized) resources, not individual hydropower facilities. (3-249): CREDA recommends the addition of a revenue table for CRSP, such as included in Tables 3-44 and 3-45.	Additional details have been added regarding the changing conditions since the 2007 Guidelines. This SEIS concerns annual release volumes from Glen Canyon Dam and does not propose changes to hydropower operations for the CRSP reservoir system across the Basin. The CRSP power units across the Basin and the need to maintain the Upper Colorado River Basin Fund are outside the scope of this SEIS. Reclamation recognizes that these components are interrelated. Appendix K of the Final LTEMP EIS analyzes environmental justice impacts and impacts on Tribal customers. Chapter 3 of the LTEMP EIS provides analysis of hydropower and marketing. Additional changes have been made per the comment.

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548	15	POWER - Electrical Power	APPENDIX A/A.3.2. HYDROPOWER GENERATION (A-7): This section should be revised to refer specifically to the provisions of the CRSP Act and the Boulder Canyon Project Act citing the hydropower authorized purposes and Reclamation's statutory obligations regarding hydropower production at Glen Canyon and Hoover Dams, respectively. Specific citation to these statutes would also be consistent with the remainder of section A.3.	Additional details have been added per the comment.
555	3	POWER - Electrical Power	The Draft SEIS was thorough, but there is a misrepresentation that the "Proposed Alternative" outperforms the "No Action Alternative" regarding hydropower. This implied outperformance of the "Proposed Alternative" is only true in 2024 for Glen Canyon Dam (GCD). Subsequent years at GCD show mixed results, and the cumulative impact of the "Proposed Alternative" is negative compared to the "No Action Alternative," except for the minimum condition in 2026 (Table 3-49).	The text above Table 3-49 states that the Proposed Action does not outperform the No Action Alternative under most hydrologic conditions.
283	1	RECREATION - Recreation	This SEIS states that under both the No Action and Proposed Action alternatives "daytime flows will not drop lower than the safe whitewater boating threshold of 5,000 cfs." (SEIS Page 3-237). GCRG contends that 5,000 cfs is NOT a safe whitewater boating threshold -- this was made abundantly clear after the mayhem that ensued from the BOR's sudden reduction of flows to 5,000 cfs in September 2023. Serious impacts included (but were not limited to): * injuries ranging from minor to major (some very serious), * numerous evacuations, some with long wait times as there were too many evacuations happening at one time. * replacement guides flown in, to take over for those who had been injured. * boat and equipment damage, including on-river repairs and motor shortages * negative impacts to the river experience for clients, * significant challenges for the National Park Service, as SAR resources were stretched thin * economic ramifications for outfitters, etc...	The safe whitewater boating threshold used in the SEIS is based on best available information, further described in analyses for LTEMP and Colorado River Management Plan (see Section 4.10.2.4 of the LTEMP FEIS). For that reason, these numbers have been used in this SEIS analysis. The draft SEIS mistakenly listed both 8,000 cfs and 5,000 cfs as the safe whitewater boating threshold, when it should be 8,000 cfs. The document has been revised accordingly. Reclamation is aware of the September 2023 event and is working with the National Park Service to provide improved notification so that boaters and outfitters can receive appropriate notice for flow changes.
297	30	RECREATION - Recreation	On page 303 of the Draft SEIS, the document states, "Whitewater boating is the key recreational activity in the Grand Canyon from Lees Ferry to the Diamond Creek or Pearce Ferry take-outs. Other reaches are not predominantly whitewater localities; therefore, they will not be discussed in this section." It fails to acknowledge anything about the returned river corridor in Cataract Canyon and flowing river on the San Juan. Referring to this area solely as "Lake Powell'' and not Glen Canyon demonstrates that reservoir recreation is favored over river recreation or ecosystems. This section solely discusses the potential impacts to reservoir and reservoir-based recreation. There is no mention of how to manage both the rivers and the reservoir. In order to fully understand the environmental and recreational impacts of reservoir operations on these sections of river, the DSEIS should have included them in its analysis. The National Park Service needs to acknowledge that there are dozens (if not hundreds) of miles of flowing river within Glen Canyon National Recreation Area, and the American public deserves	Thank you for your comment. The analysis in this document supplements the analysis in the 2007 Interim Guidelines FEIS. Like the 2007 FEIS, the SEIS's geographic scope of analysis includes the Colorado River corridor from the full pool elevations of Lake Powell to the Southerly International Boundary. As such, Cataract Canyon and the San Juan River are beyond the scope of this analysis. No change has been made to the document.
297	43	RECREATION - Recreation	If Lake Powell is to be managed at low levels moving forward, the SEIS analyses must include planning for a permanent solution for the Hite boat ramp and the broader recreation area. Without a more comprehensive approach to the evolving recreation characteristics in the park, GCNRA will be forced to simply react to problems or ignore them as they come.	The Glen Canyon NRA is managed by the NPS, not Reclamation, and is beyond the scope of this document. No change has been made to the document.

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306	3	RECREATION - Recreation	P. 2-14: In referring to why a recreation-based alternative was not considered, Reclamation claimed that "An alternative prioritizing recreation uses would not satisfy Reclamation's basic policy objectives and the requirements of the purpose of and need for Reclamation's action to protect both Glen Canyon Dam and Hoover Dam operations, system integrity, and public health and safety. It also would not comport with existing Colorado River law that governs allocation, appropriation, development, and exportation of the waters of the Basin." Nonetheless, Reclamation does, and has the responsibility to, closely consider recreational uses of the river in this SEIS. Such language could be added in this paragraph to re-affirm that portion of Reclamation's obligation.	Recreational impacts within the scope of this SEIS are appropriately considered in Section 3.14.
306	25	RECREATION - Recreation	P. 3-224: Mention should be made of two important recreational visitation changes that have occurred over the past three years between Glen Canyon Dam and Colorado River mile 1R. With the "discovery" of the Glen Canyon Reach, many thousands of paddle boarders, kayakers, and canoeists are now making day trips and overnight trips into that reach. Warmer water temperatures are enhancing the attractiveness of this visitation, and the use intensity is increasing to the point where more rigorous regulations will soon be needed. Second, the use of the Paria Beach (Mile 1R) has increased exponentially during this period as well. The Paria Beach sandbar is now the largest beach in Arizona, and it is receiving visitation by sometimes hundreds of people each day during the spring, summer, and fall months, again with warm water enhancing its attractiveness. This fast-increasing recreational use intensity should be mentioned in this section, as several companies have developed around the paddle board outfitting industry.	Thank you for your comment. A brief description of paddleboarding and day use of the reach downstream of Glen Canyon Dam to Lees Ferry has been added to the document. Visitation data is not available for Paria Beach, and has therefore not been included in the FEIS.
306	26	RECREATION - Recreation	P. 3-231: River running in Grand Canyon is strongly affected by river flows, and it is clear from this text that the concerns of river recreation companies and private river runners may not have been sufficiently included in this document. The text states "...Separation Rapid is now visible, and it is consequentially more difficult to navigate...". Separation Rapid is still a minor riffle, and mentioning it is clear evidence that the document preparators have no idea of the challenges facing river runners trying to navigate Hance or Horn Creek rapids at low flows. While neither Alternative much affects general patterns of flow, dropping flows to 5,000 cfs on a prolonged basis is likely to exacerbate navigational difficulties for river runners, as well as increasing competition among and predation within the fiver's fish assemblage. Such impacts also are relevant to us because they may reduce visitation and visitor satisfaction, and therefore reduce Grand Canyon's public constituency in support of environmental protection and rehabilitation.	Thank you for your comment. The document uses river flow data compared to threshold river flows determined using the methodology identified in the 2007 FEIS to evaluate impacts to whitewater boating. Boating navigation hazards based on threshold river flows have already been analyzed; therefore, no change has been made to the document.
314	5	RECREATION - Recreation	In addition to ensuring that all whitewater reaches within the geographic scope are included, more robust flow information needs to be employed to appropriately assess the effects of reservoir operations on whitewater boating and the industries that depend on it. Flow needs that support river recreation opportunities and sensitive environmental factors are complex, however there is robust scientific information that supports flow needs for recreation in the Grand Canyon and Cataract Canyon of the Colorado River. The alternatives need to include a robust analysis of science-based flow information for both river recreation and environmental factors that are affected by operations at Glen	Thank you for your comment. The analysis in this document supplements the analysis in the 2007 Interim Guidelines FEIS. Like the 2007 FEIS, the SEIS's geographic scope of analysis includes the Colorado River corridor from the full pool elevations of Lake Powell to the Southerly International Boundary. As such, Cataract Canyon is beyond the scope of this analysis. Reclamation recognizes that whitewater boating in the Grand Canyon is more nuanced than a singular flow minimum, however, there are limitations to assessing the nuanced impacts to whitewater boating given that the analysis relies on modeling results. As stated in the methodology section, the "analysis uses river flow data to analyze whether

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314 *(cont.)*	5 *(cont.)*	RECREATION - Recreation *(cont.)*	Canyon and Hoover Dams. In the Draft SEIS published in April 2023 and again in the Revised Draft SEIS, the Bureau made incorrect or incomplete statements about river recreation, claiming that because flows were not anticipated to be below 5,000 cfs in the Grand Canyon that recreation would only have minor changes in use value and economic activity. However, river recreation in the Grand Canyon is more nuanced than a singular flow minimum. This is well documented in a study completed by Shelby, et al. (1992), that characterized minimum acceptable flows as 10,000 cfs, optimal flows of 20,000 - 25,000 cfs, and a maximum acceptable flow of 45,000 cfs. The statement in the DSEIS regarding the 5,000 cfs minimum is not backed up with evidence or given context and the findings from studies referenced above show that the aggregate minimum acceptable flow is twice that at 10,000 cfs. The USGS has also conducted multiple studies (Neher et al., 2017; Neher et al., 2019) assessing the willingness to pay of whitewater boaters in the Grand Canyon. Both studies found that whitewater boaters have a much lower willingness to pay when flows are at 5,000 cfs compared to three other higher flow scenarios assessed. The DSEIS wrongfully states that under both alternatives, economic contributions from commercial whitewater rafting are supported under all alternatives due to minimum flow requirements..." The probability of maintaining only those minimum flow requirements as described in the Long-Term Experimental Management Plan (LTEMP) negates this claim of Reclamation as to the impacts on affected resources. We recognize that the SEIS is referring to the LTEMP for recreational flow information, however there is a lot of information in the LTEMP that is not included in the SEIS, leading to a lack of context and incorrect information in the SEIS. All three studies cited in the LTEMP, Bishop et al. (1987), Shelby et al., (1992), and Stewart et al. (2000), found that minimum safe flows were identified between 7,800 cfs and 9,200 cfs. Additionally, all of the modeled traces in the LTEMP did not return flows that were below 8,000 cfs. There is clearly additional information in the LTEMP that was not cited or reviewed to inform the SEIS and there is additional data that was not included in the LTEMP and should be included in the current NEPA process for the SEIS. The existing data that is based in science and is peer-reviewed, demonstrates that 5,000 cfs is not the only flow threshold that is needed to describe the river recreation opportunities that are affected by operations at Glen Canyon Dam. In addition to studies that have assessed flow needs for river recreation in the Grand Canyon, American Whitewater has conducted numerous flow-dependent recreation studies on the Colorado River and its tributaries in the Upper Basin. Stafford et al. (2016) extensively quantifies the flows that support river recreation opportunities in Cataract Canyon upstream from Glen Canyon, identifying both acceptable and optimal flow ranges and quantifying how often these flows occur across varying hydrological conditions (i.e., boatable day). These are just a few examples of the river recreation data that are already published and that should be integrated into the NEPA analysis for each alternative proposed for long-term operations at Glen Canyon and Hoover Dams.	there would be increased exposures to boating navigation hazards, changes in access or use of rest areas and take-outs, or changes in trip durations resulting under the Proposed Action, as compared with the No Action Alternative. (Threshold river flows were determined using the methodology identified in the 2007 FEIS)." Reclamation has reviewed the Stafford et al. 2016 publication, and has determined it is not appropriate to include as it is beyond the geographic scope in this analysis. Reclamation has confirmed that the best available scientific information regarding river flows needs for whitewater boating in the analysis area have been used. No change has been made to the document.

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557	16	RECREATION - Recreation	The Revised Draft SEIS should also have stated that receding of the Salton Sea shoreline and rising salinity because of the Proposed Action's reduced water deliveries are adverse impacts that are likely to negatively affect boating and fishing as well. Each incremental increase in exposed lakebed makes launching a boat increasingly difficult, and each incremental increase in salinity increasingly threatens the persistence of fish. Under the heading "Cumulative Effects," the Revised Draft SEIS then claims: No additive cumulative effects would on recreation due to the proposed management plan evaluated in the Salton Sea 10-Year Plan or the environmental assessment for the implementation of the 10-Year Plan's project. Essentially the Revised Draft SEIS appears to be saying that there will be no "additive cumulative" adverse impacts on Salton Sea recreation from the Proposed Action, because any negative effects will be counteracted by the alleged beneficial effects of the 10-Year Plan's projects. But, if that is the import of the above statement,67 this claim is unjustified and incorrect. As repeatedly explained above, any benefits of the 10-Year Plan's projects are entirely speculative, because those projects have not been approved or funded, the necessary water supply for their operation is not assured, and their full implementation to successful operation is extremely unlikely to occur during the period relevant to the Proposed Action and its negative impacts.	Language has been added to briefly identify adverse impacts to boat launches and fishing. Based on the EA prepared by the US Army Corps for the implementation of these projects, cumulative effects text has been revised to state that these projects would partially temper the impacts on recreation if successfully implemented.
56	1	SALTONSEA - Salton Sea	I am sending you for the record, as an attachment, my response (55 pages) to the news article titled Initial work begins on North Lake Salton Sea project with a price tag of $19.25 million published on October 20, 2023. Here is the link too: Letter to CNRA - 12-1-23 - Re the KESQ News - article titled Initial work begins on North Lake Salton project.pdf - Google Drive. In the letter is included a substantial amount of information about faultiness of the current course of action. Please read it carefully. It is important. [Commenter submitted their comments on the North Lake Salton Sea Project. See the comment letter for details.]	Comment noted.
285	2	SALTONSEA - Salton Sea	California's State Water Resources Control Board issued WRO 2002-0013, approving the QSA, more than four years after San Diego and IID first petitioned the board to approve the water transfer. WRO 2002-0013 notes that "The potential for the proposed conservation and transfer project to affect fish and wildlife in and around the Salton Sea has generated the most concern in this proceeding" (p. 2). WRO 2002-0013 required the delivery of mitigation water to the Salton Sea for a period of 15 years, "a long enough period to provide time to study the feasibility of long-term restoration actions and begin implementation of any feasible restoration projects." Twelve years later, in the absence of meaningful state funding or action at the Salton Sea, IID petitioned the SWRCB to condition "the water transfers on restoration of the Salton Sea, according to a specific timetable, and in a manner that averts the dire public-health, environmental and economic consequences that loom for the region," leading to the adoption of Order WRO 2017-0134 in 2017, almost three years after IID petitioned the SWRCB. It took another three years for California's Salton Sea Management Program (SSMP) to begin construction of the Species Conservation Habitat (SCH) project, the SSMP's first habitat restoration project. While the SCH is largely constructed, state officials indicate that it will not be operational for at least another year. The lag between WRO 2002-0013 and the time when the first significant habitat restoration project at the Salton Sea becomes operational will be 22 years or more. Salton Sea mitigation efforts - for the QSA water	This SEIS analyzes impacts at the point of delivery. Site-specific impacts are being analyzed in USACE's separate EA and in the EA for the IID 2024-2026 Temporary Colorado River System Water Conservation Project EA. Mitigation is appropriately addressed through these other NEPA processes.

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285 *(cont.)*	2 *(cont.)*	SALTONSEA - Salton Sea *(cont.)*	transfers initiated twenty years ago - have not begun to offset the impacts of the reduced inflows. There is no current mechanism to pause or halt the water transfers to ensure that the many adverse impacts of those transfers are mitigated. Environmental review of the QSA, through CEQA/NEPA and the SWRCB process, required more than four years and several amendments. The SEIS process, however, could lead to approval of hundreds of thousands of acre-feet less water flowing to the Salton Sea - a volume comparable to that of the QSA transfers - with very limited review. Currently, it does not appear as though the SWRCB will review these impacts at all. Pursuant to the Salton Sea Commitments Agreement, California has waived its own environmental review of these additional reductions. While the period of the large volumetric reductions would be limited to the years 2024-2026 (at least under the current analysis), the impacts of such reductions would manifest for many years after that. Since the QSA was signed more than twenty years ago, the surface of the Salton Sea has fallen by 12 feet and shrunk by about 33,000 acres (51 square miles). Its salinity has roughly doubled, exceeding the tolerance of almost all fish. The few fish that are left congregate near the inflows. Fish-eating bird populations have declined significantly; pelican numbers have plummeted. The SSMP has constructed a total of 22 acres of desert pupfish habitat; IID and the SSMP combined have constructed about 5,000 acres of dust suppression projects. Air quality in the region continues to decline. While the SSMP has greatly increased capacity and planning in recent years, the rate of project construction (much less completion) remains well below the rate of the Salton Sea's decline. California's recent budget challenges have exacerbated this salient problem: last year, the SSMP lost $119 million in committed state funding. Meanwhile, the QSA water transfers continue, improving water supply reliability for California and decreasing pressure on the Colorado River, at the expense of public and ecological health in the Salton Sea region. The striking disconnect between water reallocation and the implementation of required mitigation projects strongly suggests that we must make future water reduction efforts in the region contingent on verifiable mitigation. The lesson of the past 20 years at the Salton Sea is that delaying and deferring mitigation to protect current water supply reliability is not an acceptable tradeoff.	*(See above.)*

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285	9	SALTONSEA - Salton Sea	As partial mitigation for the 26 years of cumulative additional impacts that would adversely affect the Salton Sea region, Reclamation should transfer the federal land known as the "Salton Sea Test Base" to Imperial County or to the State of California. The former test base would provide appropriate mitigation for the additional adverse impacts caused by the proposed action, enabling the SSMP to construct additional habitat and dust suppression projects on land it directly controls or could access through agreements with the County. This land transfer would also enable the construction of a dedicated Salton Sea research campus, which would be an excellent resource for state and federal researchers. A research campus could include office space, a visitor center, wildlife and water quality laboratories, an air quality monitoring station, workshops, and a mobilization yard. In addition to providing appropriate mitigation for 26 years of additional adverse impacts, the Salton Sea research campus would demonstrate state and federal commitments to the Salton Sea and the value and benefits of partnerships and collaboration. Federal Land Ownership The SEIS neglects to describe the amount of federal land at the Salton Sea, some of which currently emit dust and more of which will be exposed and potentially emit dust, due to the proposed action. The federal government owns and/or manages more than 8,000 acres of exposed Salton Sea lakebed and bears responsibility for dust emitted from some of this land. In June 2022, the local air pollution control district issued a notice of violation to the US Fish & Wildlife Service for air quality violations at the Salton Sea refuge. The federal government owns about forty percent of the Salton Sea lakebed likely to be exposed during the 26 years of additional cumulative impacts identified by the SEIS. The US Fish & Wildlife Service manages the Sonny Bono Salton Sea Wildlife Refuge, supporting resident and migratory birds along the southern shoreline, and owns about 35,000 acres currently under the lake's surface. The Bureau of Land Management manages some eleven sections of former US Naval Test Base land at the southwest end of the Salton Sea. The SEIS should describe federal land ownership at and under the Salton Sea and actions it will take to protect these resources.	The transfer of lands is outside the scope of this SEIS. This SEIS analyzes impacts at the point of delivery. Site-specific impacts are being analyzed in the US Army Corps of Engineers' Salton Sea Management Program Phase 1: 10-Year Plan Environmental Assessment and IID 2024-2026 Temporary Colorado River System Water Conservation Project EA.
285	14	SALTONSEA - Salton Sea	The SEIS incorrectly dismisses these 26 years of adverse impacts on water quality, air quality, biological resources, socioeconomics, and environmental justice in the Salton Sea region. The lesson of the past 20 years at the Salton Sea is that delaying and deferring mitigation to protect current water supply reliability is not an acceptable tradeoff. We urge Reclamation to acknowledge the significant adverse impacts the proposed action will cause at the Salton Sea and make future water reductions in the Salton Sea region contingent on the four actions noted above, to help catch previously required mitigation up with statutory and contractual obligations. We further urge Reclamation to implement the additional actions recommended above, as mitigation for the additional adverse impacts likely to be caused by the proposed action.	The SEIS Proposed Action may accelerate some impacts at the Salton Sea, but is not anticipated to change the magnitude of impacts. This SEIS analyzes impacts at the point of delivery. Site-specific impacts are being analyzed in the US Army Corps of Engineers' Salton Sea Management Program Phase 1: 10-Year Plan Environmental Assessment and IID 2024-2026 Temporary Colorado River System Water Conservation Project EA.

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287	1	SALTONSEA - Salton Sea	The Revised Draft SEIS does not properly address the impending impacts of reduced inflows to the Salton Sea due to outrageous demands by the Federal Government to protect reservoir elevations on the Colorado River. The Revised Draft SEIS repeatedly shrugs off responsibility to the State and its greatly deficient 10 Year Plan To date, the Plan has failed to meet goals and is insufficient to address the impacts of additional conservation measures required by the Federal Government.	This SEIS analyzes impacts at the point of delivery. Site-specific impacts are being analyzed in the US Army Corps of Engineers' Salton Sea Management Program Phase 1: 10-Year Plan Environmental Assessment and IID 2024-2026 Temporary Colorado River System Water Conservation Project EA.
289	2	SALTONSEA - Salton Sea	Additionally, we have concerns about the evaluation of potential impacts to the Salton Sea in the RDSEIS, as discussed below. As a recent Department of Energy ("DOE") analysis found, the amount of lithium potentially extractable from beneath the Salton Sea significantly exceeds prior estimates. 1 Lithium extraction and processing uses substantial quantities of water. The DOE report found that "Regionally, the water demand for currently proposed geothermal production and lithium extraction facilities is modest, increasing demand for the region's historical Colorado River supply by ~3%. Due to the megadrought in the Colorado River basin, any increase in the region's water demand should be carefully evaluated." The agreement between the states for near-term reductions evaluated in the RDSEIS does not contemplate meeting the water needs of the lithium industry. Any deals made between California's contractors (e.g., Imperial Irrigation District, Palo Verde Irrigation District, Metropolitan Water District) and lithium companies could result in additional environmental and socioeconomic impacts. This is a reasonably foreseeable scenario that should be evaluated in the RDSEIS.	Analysis of cumulative impacts of the SEIS alternatives in combination with impacts of lithium development is too speculative to include in this SEIS. Reclamation is not aware of any proposals that have advanced to the level of detail that could be analyzed at this time.
289	3	SALTONSEA - Salton Sea	Moreover, as noted by other commenters (see, for example, comments from Jenny E. Ross), the RDSEIS does not adequately assess impacts on the Salton Sea should 2024-2026 hydrologic conditions become very dry. As the Near-Term environmental impact analysis was triggered by sustained dry conditions creating risks to water supply and power generation, it is irresponsible for the Bureau to dismiss the possibility that critical conditions could rematerialize over the next three years.	SEIS analyzed a range of hydrology including bad year projections over this short timeframe through 2026; further Salton Sea impacts are being analyzed in the US Army Corps of Engineers' Salton Sea Management Program Phase 1: 10-Year Plan Environmental Assessment and IID 2024-2026 Temporary Colorado River System Water Conservation Project EA.

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290	4	SALTONSEA - Salton Sea	2.3 (3.3.6) Salton Sea Modeling The Salton Sea is a terminal lake in Riverside and Imperial Counties, California. The Department owns and manages lands around the Salton Sea. Lake levels are maintained by runoff from the surrounding Imperial Valley and Coachella Valley watersheds, as well as agricultural runoff from the Imperial Irrigation District (IID) and Coachella Valley Water District (CVWD) originating in the Colorado River Basin. The Salton Sea acts as a sump for agricultural runoff. Reductions in agricultural runoff may impact lake elevations, which, in turn, may impact air quality and shoreline wildlife habitat. The California Natural Resources Agency is responsible for and leads management efforts at the Salton Sea. These efforts include implementing 29,800 acres of habitat restoration and dust-suppression projects on lake bed areas that have been, or will be, exposed by 2028. The Department is actively supporting the State in the implementation of its 10-year plan by providing technical resources, funding, and Department-owned lands for project implementation and has, therefore, included it in the analysis area for this SEIS. Future Salton Sea conditions were modeled using the Salton Sea Accounting Model (SSAM). The SSAM was originally developed by Reclamation in the early 2000s and repurposed by the State of California to assist in its Salton Sea Management Program objectives (California Natural Resources Agency 2018). The SSAM was used to estimate the net impacts of short-term allocation reductions on key metrics such as salinity and exposed playa area. To evaluate impacts, water allocation reduction scenarios for the IID and CVWD were evaluated using the SSAM. A set of scenarios was prepared with different levels of reduction and different fallowing/efficiency considerations by the IID. The model assumptions and outputs were reviewed by the IID, CVWD, Reclamation, and California Natural Resources Agency in a series of meetings in mid- to late-2022. A final set of updates, which includes the No Action Alternative and Proposed Action, were made in 2023 and are presented in this document. Model inputs include the initial state of the lake, freshwater inflows, and annual evaporation. To model the alternatives, different system conservation approaches proposed by the IID were used to project lake inflows. The primary outputs of the model are exposed lake bed, elevation, and salinity with data reported on an annual timestep. (underlining added). 2.3.1 My Comment: The BoR needs to be reminded that the interest of the IID is to make money and not to take care of the Salton Sea. Base on statement above it is obvious the following: (a) the BoR is accepting the "current course of action" which is based on the false assumption that the importation of the seawater is not a feasible option which was/is initiated by the Imperial Irrigation District (IID). (b) The water of the Salton Sea originates in the Colorado River Basin (See Map in section 8.1.1). Therefore, the BoR must engage in saving and restoring the Salton Sea and not participate in its destruction. (c) It appears that the IID is in charge and has control over the CNRA and BoR which is just the opposite of how it should be. Based on the well-documented record and numerous statements on which I commented in many of my public comments, of which some are included in Segment 9.0, the IID policy is not a secret - it is to get rid of the Salton Sea so that they can use some of the exposed lakebed for cultivation of farmland and some for the extraction of lithium. Based on the statement above (2.3) it is highly irresponsible that the BoR completely ignored my comments and the proposal which successfully solves all current problems of the Salton Sea.	Management of the Salton Sea is not within the scope of this SEIS.

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290	16	SALTONSEA - Salton Sea	4.6 In order to expedite the investigation process and to clarify the situation, I am recommending that the BoR and State proceeds with simple following steps - by sending a request to all those key officials who promote destruction of the Salton Sea and oppose the restoration of the Salton Sea, including all members of the UCSC Panel, to provide a written statement explaining their position. Also, I am recommending sending a request for a written comment to all consulting firms that have been involved in evaluation of any phase for the restoration of the Salton Sea including firm Kennedy Jenks and Kennedy Jank's sub-consultants to comment on my proposal - issue by issue - page by page (not to comment on bunch of other amateurish proposals which, by the way, main purpose was to muddy the water and reduce time for evaluation of my proposal) even if it covers only their specialty - hydrology - importation of seawater. With a written answer "they" (all participants) would need to speak their mind individually proving that they read it and understood it. That would reduce the possibility to hide behind the group or transfer (deflect) the blame and responsibility on someone else. By the way, the State paid $2.5 million and deserves to have a written answer from each participant of the UCSC Panel. I would be glad to help with a few questions/answers if needed. 4.7 At the same time my proposal for the restoration of the Salton Sea can be reviewed, separately by several universities, laboratories, and companies (preferably potential contractors / producers with means). That way negative influence (pressure), as was in the case with the UCSC Panel, can be minimized. The proper evaluation should not take more than one month. 4.7.1 NOTE: I am emphasizing that the focus is reviewing "my proposal" because "experts" from universities and laboratories have tendencies to believe that they are contacted (hired) to "find" the solution for the restoration of the Salton Sea themselves. We have been through such process many times in in the last 50 years and nobody have found a solution. I am emphasizing again - the solution already exists (my proposal). The state needs them (the experts) only for evaluation, based on their "expertise" whether my concept is feasible or not. By the way, my proposal is a comprehensive design that involves besides the unique architectural plan several technologies that need several experts with several expertise to evaluate it properly.	Management related to the Salton Sea is outside the scope of this SEIS.

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290	18	SALTONSEA - Salton Sea	4.9 It might not be necessary at this point because I have already solved the problem, but because I am very confident in the validity and feasibility of my concept for the restoration of the Salton Sea, I would not mind if State and BoR initiate an contest in which all capable companies around the world could compete for a design (a feasible long-term solution) provided that all competing companies respect the patent law. 4.9.1 NOTE: I am insisting that the patent law must be respected because the only feasible solution for saving and restoring the Salton Sea, despite restriction of water flow from the Colorado River, is by dividing the Salton Sea into three sections. I have several already issued patents with broad claims for such concept. 4.9.2 NOTE: In the case of opening an international contest, after providing an overview of the situation the criteria for the contest should be very simple. Here is a sample: A) Solution must be viable and technically sound for the importation of seawater whether from the Sea of Cortez or the Pacific Ocean or both. B) Solution must be viable in stopping pollution of the Salton Sea. C) Solution must be viable in respecting the Quantification Settlement Agreement (QSA) because of the limited inflow from the Colorado River. D) Solution must be viable in providing wildlife sanctuaries. E) Solution must be viable in reducing the salinity of the Salton Sea. F) Solution must be viable in providing conditions for tourism and other activities to benefit the local population, employment, and economy. G) Solution must be viable in harmonizing existing projects for the extraction of lithium from the geothermal brine and the restoration of the Salton Sea which includes the importation of seawater. H) Solution must be economically viable having a positive ratio of cost expense for the project and revenue generated from the project. I) If there are several proposals having similar but different parts or technologies, then, they should be evaluated by comparison on each difference including cost, feasibility, efficiency, and revenue generated.	Management of the Salton Sea is outside the scope of this SEIS.
290	21	SALTONSEA - Salton Sea	5.3 The State made several efforts to save and restore the Salton Sea in accordance with the State's environmental policies. The first attempt was the "Request for Information" (RFI) initiated by the State in 2017- 2018 with 11 presenters, including myself, presenting their concepts in El Centro on May 21, 2018. The second attempt was later in 2021-2022 involving the University of California Santa Cruze (UCSC). Unfortunately, those two attempts have been "sabotaged" (refusing to review the only feasible and competing proposal) by a relatively small group of people- mostly members of the Salton Sea Authority (SSA) with their influenced consultants from Tetra-Tech, Pacific Institute, and California Water Boards. My proposal for the restoration of the Salton Sea was excluded in both cases without a single scientific argument against it. By the way, members of the mentioned consulting firms competed with their own proposals (several variants of the "Perimeter/Brine Lake") during the second attempt in 2021 - 2022. 5.3.1 Here is an alternative link for the recording of that meeting in El Centro, CA on May 21, 2018: http://imperial.granicus.com/MediaPlayer.php?view_id=2&clip_id=1274. 5.3.2 Here is the link to the letter "memorandum"(1 page) from Mr. Bruce Wilcox, Assistant Secretary for CNRA sent to me on around August 16, 2018, explaining the reasons for rejecting my proposal: https://drive.google.com/file/d/1L6hDCm6H0WAEJzoDtHNVKFsgfN05iRrO/view?usp=sharing. Please read it. Mr. Bruce Wilcox did not disclose who were Committee and the	Management related to the Salton Sea is outside the scope of this SEIS.

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290 *(cont.)*	21 *(cont.)*	SALTONSEA - Salton Sea *(cont.)*	Evaluation group members and what was their background and expertise. Most importantly, he did not point out a single scientific argument against my proposal. He just brushed off. 5.3.3 Here is the link to my response (11 pages) to Mr. Bruce Wilcox's letter that I sent on October 12, 2018: https://drive.google.com/file/d/1ZCKncH0DjO834opjcXmCZSKbjX27JE7a/view?usp=sharing. 5.3.4 Here is the link to my response (28 pages) to the UCSC Panel's decision regarding two Fatal Flaws' filed on June 20, 2022. https://drive.google.com/file/d/1GZVU1FRSS4bFu1J2n3d31vNjfCu3brCz/view?usp=sharing. This letter has a substantial amount of information including my correspondence (argument) with the Panel of independent reviewers. Please read it. 5.3.5 NOTE: Here is the link to the letter (62 pages) that I sent to You Honorable Wade Crowfoot, Secretary for California Natural Resources Agency, on December 30, 2022, in response to the Salton Sea Independent Review Panel Summary Report published on or around September 29, 2022. In my response, I provided plenty of evidence of blatant breach of the Panel task and requested abolishment of the fraudulent report. Here is the link: https://drive.google.com/file/d/1wzN6xylytehWJu0Nz_wZFkTtAi9mYCS/view?usp=sharing. This letter has a substantial amount of information including my correspondence with the Panel of independent reviewers. Also, have the links to a recorded meeting in which principal investigator Professor Dr. Brant Haddad explained the reasons for not reviewing my proposal (See page 14 out of 62). Please read it. 5.3.6 Here is the link to my response (10 pages) to the UCSC Panel after the televised meeting on July 20, 2022 - filed on July 22, 2022. https://drive.google.com/file/d/1_3C4HgL3tan6TFz5iM5g1dyuFXz-TkwQ/view?usp=sharing. 5.3.7 Here is an important video from the meeting conducted on July 20, 2022. Video: Independent Review Panel Fatal Flaw Report Public Meeting July 20, 2022. https://saltonsea.ca.gov/planning/water-importation-independent-review-panel/ 5.3.8 NOTE: Please pay attention to the answer of Dr. Brant Haddad after my comment at segment 1:19:07 - 1:26:50. He is talking about the relationship between the Panel and Tetra-Tech which supposedly is implementing the State's policy on the Salton Sea. It is important to clarify that Tetra-Tech is only a consulting firm and, in this case, gives bed advice to the State on matters that are not in harmony with environmental law. I am pleased that Dr. Brant Haddad admits that he asked Tetra-Tech for their Salton Sea Management Program (SSMP) model, which then the Panel used for analysis. I do not mean to be disrespectful to the Panel's Dr. Brant Haddad, but such a practice (conduct) is highly inappropriate and illegal. Here is his exact answer: "The most important thing that I can address Nikola in your comment has to do with the relationship between the Panel and Tetra-Tech. So, Tetra-Tech is consulting firm that is working with the State on its ... I guess you would call it the In Sea Solution " in any way" the Tetra-Tech is working with State on the Salton Sea issue and the independent review Panel is operating independently from Tetra-Tech and the only connection that we have with Tetra-Tech has been in asking them for their version of the SSMP model which then we used for our analyses. ... So, I think that we might have a training session where Tetra-Tech said here is how you use it .... But that is the extent of the relationship ... The	*(See above.)*

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290 *(cont.)*	21 *(cont.)*	SALTONSEA - Salton Sea *(cont.)*	rest of the analyses have been done by the Panel and its support team and the support team has included professors, graduate students from UC Santa Cruz as well as consultants firm Kennedy Jenks and Kennedy Jenks' subconsultants. So, there has been a separation between the State and this project, and we have really gone out of our way so that we maintain that wall ... so that the Panel is seen as independent ". 5.3.8.1 NOTE: The reality is that Tetra-Tech and Pacific Institute with their influential and persuasive friends from SSA and IID, used their status as State's consultants - acting as the State's voice or enforcers of State policy - to overcome the Panel's "independent" status and took over evaluations of the proposals for the restoration of the Salton Sea. They excluded the only competition (my proposal), and then later easily eliminated those three proposals that supposedly passed the "Fatal Flaw Criteria" and reinstated their ill-conceived proposal as a front-runner and the only feasible proposal to follow. By doing so, they made the Panel of independent reviewers irrelevant. Therefore, the Panel's report must be abolished (rejected), and an investigation opened with reevaluation of my proposal. By the way, evaluation of my proposal did not happen. They just brushed off. Also, it is important to mention on this point that Tetra-Tech's using "State's consultant status" to act as enforcers of State's policy is a blatant breach of their task and clearly manipulative conduct. I am pleased that the meeting on July 20, 2022, has been recorded. This is an unbelievable, but truthful admission (confession). The Panel's Dr. Brant Haddad's words and conduct, especially Panel's Report are legitimate grounds for a tribunal. It is strong evidence for the abolishment of the UCSC Panel's Report and for opening an investigation and starting a speedy new evaluation of my proposal with adequate reviewers (See my recommendation in Segment 6.0. 5.3.9 NOTE: Just to back up a little bit. In 2021 the State initiated, rightfully so, the new request for information (RFI) for the re-examination of the 11 initial proposals with the assistance of the University of California Santa Cruz (UCSC). The UCSC formed the Panel of independent reviewers (Panel) chaired by Dr. Rominder Suri and the principal investigator Professor Dr. Brant Haddad. Here is the link to the agreement between the Department of Water Resources (DWR) and the UCSC Panel, based on Executive Order N-10- 19, to conduct a Feasibility Study to objectively evaluate the merit of water importation as a potential long-term strategy for the restoration of the Salton Sea: Agreement Summary - Contract for UCSC panel 1[22396].pdf. The authors of the initial 11 proposals had an opportunity to update their original proposals if needed. Also was given an opportunity to submit new proposals if there are any. An additional 7 new proposals were submitted by the deadline of October 12, 2021. Since the authors of each proposal believe that their proposal is the best and needs to be implemented, we needed a "referee". The main purpose of the UCSC Panel was/is to evaluate all submitted proposals and select the best one that is feasible, and most beneficial to the restoration of the Salton Sea, the environment, the nearby communities, and the economy in general. The UCSC Panel blatantly failed to fulfil its main task, but they did receive $2.5 million for their lousy work.	*(See above.)*

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290	27	SALTONSEA - Salton Sea	6.1 I respectfully urge BoR, again, to reconsider its decision and include the Salton Seas, not just in "Post-2026 Operation", but to enforce its own policy and in cooperation with CNRA and Army Corps of Engineers open investigation and work on speedy evaluation of my proposal for the restoration of the Salton Sea. The Bureau of Reclamation (BoR) needs to be aware that the restoration of the Salton Sea is of enormous importance not just for the local population but for the environment and the State of California and United States of America. We have already lost a lot of time and money unnecessarily - just because of the incompetence of "local leadership" and a few state officials.	Management related to the Salton Sea is outside the scope of this SEIS.
310	7	SALTONSEA - Salton Sea	Similarly, Reclamation states that the Proposed Action will have a greater impact on special status species at the Salton Sea because of decreased water level and increased salinity (p. 3-219). Again, how does Reclamation propose to mitigate this loss, given that the Proposed Action prevents it from being avoided? The Salton Sea is physically, historically, and practically part of the Colorado River watershed and has become an essential stopover and wintering area on the Pacific Flyway. If subjected to further diminished inflows, this area promises to become a major biological, economic, health, and social justice disaster. Preventing such a disaster in the Salton Sea region (i.e., parts of Imperial and Riverside Counties) will require maintaining adequate inflows, which are nearly wholly dependent on runoff from Imperial County farms and wastewater from Mexicali. The RDSEIS has failed to fully analyze, avoid, minimize, or mitigate all potential direct and indirect project impacts on biological, health, and economic resources at the Salton Sea and other areas affected by its Proposed Action. Indeed, the Imperial Irrigation District declined to sign on to the 2019 Colorado River Drought Contingency Plan (DCP) and went to court over it against the Metropolitan Water District largely because of the DCP's failure to mitigate for impacts to the Salton Sea. We recognize that establishing a sustainable environment at the Salton Sea is a challenging problem that will require effort and resources from the Bureau, the State of California, the Federal Government, and others, but it needs to be done without further delay.	Mitigation for biological resources is described in the Biological Assessment. Impacts on the Salton Sea are described under cumulative effects, as Reclamation analyzes impacts at the point of delivery. Separate actions at the Salton Sea to address biological and public health issues are ongoing. The Salton Sea Management Program (SSMP) Phase 1: 10-Year Plan (2018-2028) identifies a goal to create 29,800 acres of aquatic habitat and dust suppression projects to improve conditions around the Salton Sea. To assist in implementation of the of the SSMP, the Department of Interior has authorized $250,000,000 to support and expedite the implementation of projects at the Salton Sea (December 2022). This funding is planned to expand the Species Conservation Habitat Project, adding up to 7,000 acres of aquatic restoration to the 4,100 acres already constructed at the project site. Please refer to the Annual Report on the Salton Sea Management Program (2023, CNRA) for more information related to on ongoing efforts and prior year accomplishments.

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326	7	SALTONSEA - Salton Sea	Salton Sea The Proposed Action indicates that 840,000 acre-feet of additional water conservation would be undertaken by Imperial Irrigation District (750,000 acre-feet) and Coachella Valley Water District (90,000 acre-feet) between 2024 and 2026. These conservation actions are in addition to water conservation commitments made under the Quantification Settlement Agreement. The SEIS generally states that the impacts to the Salton Sea will be similar under the No Action Alternative and the Proposed Action. However, the three-year reduction of 840,000 acre-feet of water deliveries to the two water districts is significant. The Service anticipates that these three year reductions may result in declines in Salton Sea elevation, increases in Salton Sea salinity and exposed lakebed, and the loss of irrigation drain fed wetlands around the Salton Sea due to less water being drained off Imperial County and Coachella Valley agricultural fields. These effects would be cumulative and be in addition to what would occur under the No Action Alternative, and therefore the impacts may not be similar. Further, as the Salton Sea has receded, some agricultural drains no longer reach the Salton Sea but empty onto the exposed lakebed and have formed wetlands that support the federally listed desert pupfish and Yuma Ridgway's rail. The Proposed Action could result in loss of in the extent of these wetlands and a decline in water quality, which would result in loss of habitat to listed species. Please revise the analysis accordingly and include a discussion of the occurrence of Yuma Ridgway's rail and desert pupfish in the wetland areas downstream of the agricultural drains. The Service's biological opinion for the Salton Sea 10-Year Management Program, issued to the Army Corps on February 23, 2023, can provide baseline desert pupfish occurrences in these locations.	As discussed in Section 3.13.2, Issue Statement #3, both the No Action and the Proposed Action would result in reduced flows to the Salton Sea, "exacerbating existing issues of water availability and salinity for special status species." Such reductions are assumed in the Salton Sea 10-Year Management Program and Biological Opinion. Only difference between current trends and the Proposed Action, is the flow reductions could occur sooner than under No Action.
326	12	SALTONSEA - Salton Sea	[Section 2.1, table 2-9, page 2-25] The Proposed Action indicates that between 2024 and 2026, 840,000 acre-feet of additional water conservation would be undertaken by Imperial Irrigation District and Coachella Valley Water District (Table 3-3). This water conservation is in addition to commitments made under the Quantification Settlement Agreement (QSA), so declines in Salton Sea elevation, increases in Salton Sea salinity, and increases in exposed lakebed around the Sea would be cumulative and be in addition to what would occur under the No Action Alternative. This analysis should be confined to the analysis timeframe, that is, through 2026. Also, the draft SEIS limits the analysis to water inputs into the Salton Sea. We recommend the analysis also include effects to the approximately 1,500 acres of wetlands that have become established on the exposed lakebed at the end, and downstream, of the irrigation drains that drain onto the exposed lakebed.	Nothing considered in the SEIS Proposed Action is changing impacts from what has previously been analyzed for Salton Sea lakebed exposure by the USACE. While it may accelerate exposure, it will not change total exposure. This SEIS analyzes impacts at the point of delivery. Site-specific impacts are being analyzed in the US Army Corps of Engineers' Salton Sea Management Program Phase 1: 10-Year Plan Environmental Assessment and IID 2024-2026 Temporary Colorado River System Water Conservation Project EA.

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326	13	SALTONSEA - Salton Sea	[Section 2.1, Table 2-9, Page 2-27] Salton Sea lakebed exposure will likely increase under the Proposed Action. California's commitment to 1.6 million acre-feet of additional water conservation between 2024 and 2026 is in addition to commitments made under the Quantification Settlement Agreement, and based on Table 3-3, most of this water conservation will come from water reductions to the Imperial Irrigation District (750,000 acre-feet) and the Coachella Valley Water District (90,000 acre-feet) so the declines in Salton Sea elevation, increases in Salton Sea salinity and exposed lakebed, and loss of irrigation drain fed wetlands around the Salton Sea could occur due to less water being drained off Imperial County and Coachella Valley agricultural fields. These effects would be cumulative and be in addition to what would occur under the No Action Alternative. Please revise the analysis accordingly.	Actions considered in this SEIS are not the main drivers of change in Salton Sea exposed lakebed. There are many sources of dust emissions in the Imperial Valley, and Reclamation acknowledges that the Salton Sea is one of them. This SEIS is analyzing a short timeframe of the remainder of the interim period, through 2026. Further, the total amount of lakebed exposure does not vary between the No Action Alternative and the Proposed Action in this SEIS. The SEIS Proposed Action and the No Action Alternative would result in the same level of lakebed exposure; the alternatives only vary in the rate of exposure. Topics mentioned by the commenter are being analyzed in separate NEPA efforts such as the USACE Salton Sea Management Program Phase I: 10-Year Plan EA and the IID 2024-2026 Temporary Colorado River System Water Conservation Project.
326	18	SALTONSEA - Salton Sea	[Section 2.1, table 2-9, page 2-29] As the Salton Sea has receded, some agricultural drains no longer reach the Salton Sea but empty onto the exposed lakebed and vegetation assemblages have formed that support wetland and riparian plant species. These wetlands also support desert pupfish and Yuma Ridgway's rail. The proposed action could result in loss of in the extent of these wetlands and a decline in water quality, which would result in loss of habitat to listed species. Please revise the analysis accordingly.	Nothing considered in the SEIS Proposed Action is changing impacts from what has previously been analyzed for Salton Sea lakebed exposure by the USACE. While it may accelerate exposure, it will not change total exposure. This SEIS analyzes impacts at the point of delivery. Site-specific impacts are being analyzed IID 2024-2026 Temporary Colorado River System Water Conservation Project EA.
326	22	SALTONSEA - Salton Sea	[Section 3.13 Page 3-194] The draft SEIS concludes the Proposed Action would cause a decrease in water level and a corresponding increase in exposed playa beginning in late 2025/early 2026 as compared with the No Action Alternative. Please include a discussion in this section describing how the SEIS water conservation would affect the approximately 1,500 acres of permanent wetlands that occur around the Salton Sea where the agricultural drains back up or flood, which was described in section 3.13 on page 3-169.	This SEIS analyzes impacts at the point of delivery. Site-specific impacts are being analyzed in the IID 2024-2026 Temporary Colorado River System Water Conservation Project EA.
326	45	SALTONSEA - Salton Sea	[Section 3.13.2, page 3-195] "Slight reductions in water levels and increased salinity in the Salton Sea will likely have no detrimental impact on fisheries if sufficient input of freshwater is present." Explain whether or not sufficient freshwater input is present. Also, this sentence conflicts with a later sentence "reduction in flow and increased salinity may reduce habitat for tilapia," the only fish species present in Salton Sea. Loss of habitat would be a detrimental effect. Please resolve.	This SEIS analyzes impacts at the point of delivery. A comprehensive analysis of effects at the Salton Sea is currently in progress through distinct National Environmental Policy Act (NEPA) processes. These processes include the U.S. Army Corps of Engineers - Salton Sea Management Program (SSMP) Phase 1: 10-Year Plan (2018-2028) and the IID 2024-2026 Temporary Colorado River System Water Conservation Project. Reclamation's understanding is that tilapia are not present in any significant numbers in the main body of water due to salinity levels. However, there are sustained tilapia populations at and near the drain connections to the Salton Sea, where inflows are less saline and capable of providing suitable water quality conditions. Change made to the SEIS.

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326	61	SALTONSEA - Salton Sea	[Section 3.7.8, page 3-84] It is unclear why the potential for additional Salton Sea lakebed exposure refers to a 26-year timeframe. The draft SEIS evaluates near-term operations through 2026 and does not discuss hydrological scenarios for the next 26 years. Therefore, we recommend this analysis be revised to reflect Salton Sea lakebed exposure through 2026 and how that would differ from the No Action Alternative through 2026. Also, the 750,000 acre-feet of additional water conservation between 2024 and 2026 by Imperial Irrigation District is in addition to commitments made under the QSA, so the effects on Salton Sea elevation, exposed lakebed, salinity, and irrigation drain fed wetlands would be cumulative and be in addition to what would occur under the No Action Alternative.	Nothing considered in the SEIS Proposed Action is changing impacts from what has previously been analyzed for Salton Sea lakebed exposure by the USACE. While it may accelerate exposure, it will not change total exposure. This SEIS analyzes impacts at the point of delivery. Site-specific impacts are being analyzed in the US Army Corps of Engineers' Salton Sea Management Program Phase 1: 10-Year Plan Environmental Assessment and IID 2024-2026 Temporary Colorado River System Water Conservation Project EA.
555	6	SALTONSEA - Salton Sea	* Was the Salton Sea part of the 2007 Interim Guidelines, if not, why is it added now?	The cumulative impacts addressed in the 2007 Interim Guidelines EIS focused on other regional water supply or closely related projects in the region, and did not analyze the Salton Sea. The Salton Sea was included in this analysis based on input from the public and cooperating agencies.

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557	1	SALTONSEA - Salton Sea	As all Colorado River stakeholders understand, a chronic and major imbalance between water supply and demand continues to exist on the river, and the situation is unsustainable. Although favorable hydrology during the winter of 2022-2023 temporarily relieved some pressure to implement immediate and enormous reductions in water use, there remains an undeniable need for substantial cuts in water consumption both now and in the future. However, reductions in Colorado River water deliveries to Salton Trough water rights holders "IID, CVWD, and Mexico" will decrease the amount of water flowing into the central Salton Basin that is necessary for sustaining the Salton Sea. Consequently, such cutbacks will worsen the dreadful ecological, environmental, public health, and socioeconomic consequences that are already ongoing at the Salton Sea because of the QSA water transfers, and that have been inadequately addressed for many years by the responsible state and federal government agencies. In May 2023, the three U.S. states in the Colorado River's Lower Division submitted a joint proposal (the Lower Division Proposal) to USBR for addressing the river's ongoing water-supply deficit during 2024- 2026, and Reclamation has now designated the Lower Division Proposal as the agency's Proposed Action in the Revised Draft SEIS. But the magnitude of the decrease in Salton Sea inflows that will result from the Proposed Action is currently uncertain, because the specific details regarding reduced water use by IID and CVWD are still being negotiated and are not included in the Revised Draft SEIS. However, on December 1, 2023 IID announced it has proposed to USBR that, in order to support sustainability of the Colorado River system during 2024-2026, IID will plan to conserve an extra 800,000 acre-feet of Colorado River water it would otherwise be legally entitled to use. This very large quantity of conserved water will be in addition to the amount of water IID conserves and transfers annually pursuant to the QSA, which is approximately 500,000 acre-feet per year. But there is still no public information regarding precisely how the Imperial Valley agricultural community will conserve an additional 800,000 acre-feet of water during 2024-2026, and those key unknown details will determine the magnitude of the consequent decrease in Salton Sea inflows. Some potential measures for conserving water will result in much greater reductions in Salton Sea inflows than other measures. Nonetheless, based upon historical information, it appears that the volume of water reaching the lake will decrease by a minimum of approximately 267,000 acre-feet during 2024-2026 if 800,000 acre-feet are conserved; and, depending on the specific types of water conservation measures that are implemented in the Imperial Valley, Salton Sea inflows could drop by a much larger amount than that.6	This SEIS analyzes impacts at the point of delivery. A comprehensive analysis of effects at the Salton Sea is currently in progress through distinct National Environmental Policy Act (NEPA) processes. These processes include the U.S. Army Corps of Engineers - Salton Sea Management Program (SSMP) Phase 1: 10-Year Plan (2018-2028) and the IID SEIS system conservation actions.
557	2	SALTONSEA - Salton Sea	Any action alternative for managing the Colorado River that reduces water use by Salton Trough rights holders will necessarily accelerate and exacerbate the harmful impacts of freshwater deprivation that are already affecting the Salton Sea, hundreds of wildlife species, the environment, the climate, and the health and socioeconomic well-being of people throughout the surrounding region. The federal government is legally obligated to avert that harm by avoiding or minimizing the foreseeable negative impacts of federal actions to the greatest feasible extent, in compliance with the National Environmental Policy Act (NEPA),7 the NEPA implementing regulations,8 and other applicable statutes, regulations, and policies.	All additional water reductions to water right holders are voluntary under the Proposed Action. Some entities may choose to participate in the voluntary system conservation opportunities described in the Proposed Action. The voluntary conservation would also increase reservoir levels compared with the No Action alternative, making additional mandatory shortages under the 2007 Interim Guidelines less likely. Impacts to the Salton Sea are discussed as cumulative impacts and site specific impacts from conservation are being assessed in the IID 2024-2026 Temporary Colorado River System Water Conservation Project EA.

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557	3	SALTONSEA - Salton Sea	Notwithstanding the above facts and legal requirements, the Revised Draft SEIS presents an inadequate discussion of: (a) the significant direct, indirect, cumulative, and disproportionate negative impacts on the Salton Sea, the wildlife reliant on the Salton Sea ecosystem, the environment, the climate, and people throughout the areas adjacent to the lake "including, but not limited to, Tribes and other environmental justice communities" that foreseeably will result if Reclamation proceeds with the Proposed Action or any other action alternative that substantially reduces inflows to the central Salton Basin; (b) alternatives for avoiding the foregoing adverse impacts; and (c) effective mechanisms for minimizing the harmful effects that cannot be avoided.	Actions considered in this SEIS are not the main drivers of change in Salton Sea exposed lakebed. There are many sources of dust emissions in the Imperial Valley, and Reclamation acknowledges that the Salton Sea is one of them. This SEIS is analyzing a short timeframe of the remainder of the interim period, through 2026. Further, the total amount of lakebed exposure does not vary between the No Action Alternative and the action alternatives in this EIS. The SEIS alternatives and the No Action alternative would result in the same level of lakebed exposure; the alternatives only vary in the rate of exposure. Topics mentioned by the commenter are being analyzed in separate NEPA efforts such as the USACE Salton Sea Management Program Phase I: 10-Year Plan EA and the IID 2024-2026 Temporary Colorado River System Water Conservation Project. For instance, the IID 2024-2026 Temporary Colorado River System Water Conservation Project EA will have resource analysis section on Air Quality, Environmental Justice, and Human Health.
557	4	SALTONSEA - Salton Sea	The modeling Reclamation relies upon to draw conclusions about Salton Sea impacts is not publicly available, adequately explained, or properly validated and justified. The Revised Draft SEIS and its Appendices include extensive explanatory details and supporting documentation regarding the Colorado River modeling relied upon by Reclamation; however, the Revised Draft SEIS does not include comparable information concerning the "Salton Sea Modeling" Reclamation also relies upon. Instead, the modeling used in the Revised Draft SEIS to reach conclusions about Salton Sea Impacts is a black box, the keys to which have been withheld from the public.9 That is untenable. The model used (by Tetra Tech, on behalf of USBR) for the Revised Draft SEIS's "Salton Sea Modeling" is identified as a modified version of the Salton Sea Accounting Model (SSAM), which was originally developed by Reclamation more than two decades ago- prior to the QSA, and before the worst drought in at least 1200 years desiccated the Western U.S. and northwest Mexico and provided troubling insight into the potentially devastating future impacts of climate change throughout the Colorado River basin. Since 2000 that model has been repeatedly altered by Tetra Tech, and possibly others, and utilized for a variety of purposes, including a number of purposes related to the Salton Sea Management Program (SSMP). The modified versions of the model used for SSMP purposes have not been publicly disclosed, and they do not appear to have been properly validated for the specific functions involved, or peer-reviewed by independent experts. Now it appears that the SSAM has again been modified by Tetra Tech, and is being used to perform more purposes for which it has apparently not been validated. Again the modified model is not publicly available, and it is impossible for independent experts or other members of the public to evaluate its validity or the soundness of its use. The details of the assumptions and hypothetical scenarios utilized to perform the "Salton Sea Modeling" for the Revised Draft SEIS also have not been publicly disclosed; therefore, independent experts and other members of the public cannot assess their appropriateness and accuracy either. Based on this nonpublic modeling, the Revised Draft SEIS makes important findings about Salton Sea Impacts (or the alleged lack thereof) that are unjustified, inappropriate, erroneous, and even illegitimate. It is indefensible for the Revised Draft SEIS to rely on undisclosed and potentially unsound modeling to reach consequential conclusions, and to expect the public simply to accept those conclusions at face value.	The SSAM model represents the best available tool to evaluate inflow impacts to Salton Sea surface water elevation and uses widely accepted hydrological modeling practices. Although the California Natural Resource Agency (CNRA) does not post the SSAM model online, it is available to the public, scientific professionals, and partner agencies upon request. CNRA, US Army Corps, US Geologic Service, Reclamation and other partner agencies will evaluate the tool and update its parameters as necessary to support the ongoing Imperial Streams, Salton Sea, and Tributaries Feasibility Study

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557	5	SALTONSEA - Salton Sea	The Revised Draft SEIS does not adequately discuss the significant direct, indirect, cumulative, and disproportionate negative impacts on the Salton Sea, the surrounding environment, the wildlife reliant on the Salton Sea ecosystem, and people throughout the region adjacent to the lake, including but not limited to Tribes and other environmental justice communities, that foreseeably will result if Reclamation proceeds with the Proposed Action or any other action alternative that substantially reduces inflows to the central Salton Basin. Some reasonably foreseeable and significant negative impacts are not mentioned at all in the Revised Draft SEIS, and others are insufficiently and/or inappropriately analyzed. Conclusions drawn in the Revised Draft SEIS regarding adverse impacts related to the Salton Sea are unsupported, inaccurate, and/or improper; and the mitigation measures suggested for addressing the negative effects are inadequate and speculative, and will be ineffective.	This SEIS analyzes impacts at the point of delivery. A comprehensive analysis of effects at the Salton Sea is currently in progress through distinct National Environmental Policy Act (NEPA) processes. These processes include the U.S. Army Corps of Engineers - Salton Sea Management Program (SSMP) Phase 1: 10-Year Plan (2018-2028) and the IID 2024-2026 Temporary Colorado River System Water Conservation Project.
557	6	SALTONSEA - Salton Sea	Law of the River The District, and other water users on the River, have come to rely on the Law of the River and the Bureau's commitment to it and the water delivery contracts signed by the United States many decades ago. A key tenet of the Law of the	This SEIS analyzes impacts at the point of delivery. A comprehensive analysis of effects at the Salton Sea is currently in progress through distinct National Environmental Policy Act (NEPA) processes. These processes include the U.S. Army Corps of Engineers - Salton Sea Management Program (SSMP) Phase 1: 10-Year Plan (2018-2028) and the IID 2024-2026 Temporary Colorado River System Water Conservation Project. The SSAM model represents the best available tool to evaluate inflow impacts to Salton Sea surface water elevation and uses widely accepted hydrological modeling practices.
557	19	SALTONSEA - Salton Sea	It is reasonably foreseeable that many types of significant harm to wildlife and people will occur during 2024-2026 if Reclamation proceeds with the Proposed Action or another action alternative that will substantially decrease freshwater inflows to the Salton Sea. In addition, as partially acknowledged by the Revised Draft SEIS, some negative impacts caused by the Proposed Action will persist far beyond 2026, and they will result in worsening consequences for many years thereafter. Furthermore, some of those harmful effects will be irreversible. It is therefore essential, and legally required, for Reclamation to identify effective measures: (a) for avoiding the negative effects that will foreseeably result from reduced inflows to the Salton Sea during 2024-2026; and (b) for minimizing the negative effects of those inflow reductions to the greatest feasible extent if they cannot be avoided. But Reclamation failed to address these matters appropriately in the Revised Draft SEIS. Thus, if USBR decides to proceed with the Proposed Action or any other action alternative that will substantially decrease inflows to the Salton Sea, the final SEIS and Record of Decision must describe and select effective harm-avoidance and mitigation measures to protect wildlife, people, and the environment from foreseeable injurious consequences, and Reclamation must expeditiously implement those measures.	This SEIS analyzes impacts at the point of delivery. Actions considered in this SEIS are not the main drivers of change in Salton Sea exposed lakebed. There are many sources of dust emissions in the Imperial Valley, and Reclamation acknowledges that the Salton Sea is one of them. This SEIS is analyzing a short timeframe of the remainder of the interim period, through 2026. Further, the total amount of lakebed exposure does not vary between the No Action Alternative and the Proposed Action in this SEIS. The SEIS Proposed Action and the No Action Alternative would result in the same level of lakebed exposure; the alternatives only vary in the rate of exposure. Topics mentioned by the commenter are being analyzed in separate NEPA efforts such as the USACE Salton Sea Management Program Phase I: 10-Year Plan EA and the IID 2024-2026 Temporary Colorado River System Water Conservation Project.

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557	20	SALTONSEA - Salton Sea	The Revised Draft SEIS does not analyze, or present potential remedies for, the Salton Sea Impacts that may occur if Reclamation's modeling of Colorado River water availability for 2024-2026 is overly optimistic, and/or if the agency's "Salton Sea Modeling" underestimates decreases in Salton Sea inflows. I suggest it is essential for those analyses to be included in the final SEIS and Record of Decision. It is reasonably foreseeable that the hydrology of the Colorado River basin from January 2024 through December 2026 may be drier than anticipated in the modeling performed by Reclamation for the Revised Draft SEIS and relied upon in formulating the Proposed Action. If that very dry hydrological scenario occurs, substantial additional reductions in water deliveries to Colorado River water rights holders will likely be required. Similarly, it is also reasonably foreseeable that the "Salton Sea Modeling" may underestimate the actual decreases in Salton Sea inflows that could occur during 2024-2026. Consequently, there could be far worse impacts than Reclamation currently expects for the Salton Sea, the wildlife reliant on the Salton Sea ecosystem, the environment across the Salton Sea region, the climate, and people throughout the areas surrounding the lake including, but not limited to, Tribes and other environmental justice communities. Although the Revised Draft SEIS mentions the possibility of drier hydrology than modeled for 2024-2026, the text does not discuss the ramifications of that situation for Salton Sea Impacts, and does not identify effective mitigation measures to be implemented in the event such dire circumstances materialize. I suggest that a crisis of that nature and magnitude must be anticipated and appropriately analyzed by Reclamation, and the agency must plan to avoid or minimize the resulting harm to wildlife and people at the Salton Sea to the greatest feasible extent.	Impacts to the Salton Sea are described under cumulative effects, as Reclamation analyzes impacts at the point of delivery. The hydrologic modeling examines scenarios based on flows in the Basin over the past 30 years (not the 30-year average), which includes the driest 23-year period on record. To examine even worse drought conditions, the hydrologic modeling examines Basin flow scenarios with 90 percent and 80 percent of the flows seen over the past 30 years (up to a 20 percent reduction in flows compared with the last 30 years). Reclamation believes the range of hydrology scenarios analyzed is an appropriate worst case to analyze for conditions that might occur between now and 2026.

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557	21	SALTONSEA - Salton Sea	At various places in the Revised Draft SEIS where the text discusses impacts on locations and resources along the Colorado River not including the Salton Sea, the document presents the following statements: "No cumulative effects would occur on the landscape character near Lake Powell and Lake Mead from the proposed management plan evaluated in the Salton Sea 10-Year Plan or the environmental assessment for the implementation of the 10-Year Plan's projects."81 [See comment letter for additional statements] These irrelevant assertions seem to be based on, or were copied and pasted from, an unrelated NEPA analysis. They do not belong in the Revised Draft SEIS. Moreover, they inappropriately turn on its head the analysis of Salton Sea issues that Reclamation is required to perform in the Revised Draft SEIS. Reclamation is obligated to evaluate the direct, indirect, and cumulative adverse impacts of the Revised Draft SEIS's Proposed Action for near-term Colorado River operations on the Salton Sea, the wildlife reliant on the Salton Sea ecosystem, the environment, and people across the surrounding area. But in the above statements Reclamation is essentially doing the reverse of what it is supposed to do. The agency is purporting to evaluate potential impacts on the Colorado River from projects proposed in the draft Salton Sea 10-Year Plan. That is improper. The draft 10-Year Plan is not part of proposed near-term Colorado River operations; rather, it is a pre-existing plan intended to accomplish short-term mitigation of harm that is occurring to the Salton Sea, wildlife reliant on the Salton Sea ecosystem, the environment, and people throughout the Salton Sea region because of previous Colorado River management decisions related to the QSA water transfers. It is not within the scope of the Revised Draft SEIS for Reclamation to evaluate the possible effects of the draft Salton Sea 10-Year Plan on the Colorado River or related mainstream resources.	Impacts to the Salton Sea are described under cumulative effects, as Reclamation analyzes impacts at the point of delivery. It is logical to include the 10-Year Plan and draft analysis in cumulative impacts as it is a known effort currently being implemented by the State of California. Reclamation is not evaluating the effects of the 10-Year Plan on the Colorado River or related mainstream resources. Further, the total amount of lakebed exposure does not vary between the No Action Alternative and the Proposed Action in this SEIS. The SEIS Proposed Action and the No Action Alternative would result in the same level of lakebed exposure; the alternatives only vary in the rate of exposure. Topics mentioned by the commenter are being analyzed in separate NEPA efforts such as the USACE Salton Sea Management Program Phase I: 10-Year Plan EA and the IID 2024-2026 Temporary Colorado River System Water Conservation Project. For instance, the IID 2024-2026 Temporary Colorado River System Water Conservation Project EA will have resource analysis section on Biological Resources, Air Quality, Environmental Justice, and Human Health. Separate actions at the Salton Sea to address biological and public health issues are ongoing. The Salton Sea Management Program (SSMP) Phase 1: 10-Year Plan (2018-2028) identifies a goal to create 29,800 acres of aquatic habitat and dust suppression projects to improve conditions around the Salton Sea. To assist in implementation of the of the SSMP, the Department of Interior has authorized $250,000,000 to support and expedite the implementation of projects at the Salton Sea (December 2022). This funding is planned to expand the Species Conservation Habitat Project, adding up to 7,000 acres of aquatic restoration to the 4,100 acres already constructed at the project site. Please refer to the Annual Report on the Salton Sea Management Program (2023, CNRA) for more information related to on ongoing efforts and prior year accomplishments.

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557	24	SALTONSEA - Salton Sea	Salton Sea Impacts resulting from the Proposed Action will likely be less severe than the adverse impacts from some previously proposed alternatives that have since been rejected by Reclamation; however, it is clear the Proposed Action will have injurious effects on the Salton Sea, wildlife, the environment, the climate, and people who live and work in areas adjacent to the lake-including, but not limited to, Tribes and other environmental justice communities. The Revised Draft SEIS does not adequately or even appropriately discuss many foreseeable and significant negative Salton Sea Impacts of the Proposed Action, and fails to suggest effective mechanisms for avoiding those impacts or for minimizing the detrimental effects that are impossible to avoid. In these and other respects, the Revised Draft SEIS does not satisfy applicable legal requirements. In preparing the final SEIS and Record of Decision, Reclamation must properly address all deficiencies in the Revised Draft SEIS related to the Salton Sea. Most crucially, Interior must expeditiously plan and undertake effective actions to ensure that significant injurious consequences for people, wildlife, and the environment in the Salton Sea region do not occur as a result of Reclamation's near-term Colorado River operations.	Impacts to the Salton Sea are described under cumulative effects, as Reclamation analyzes impacts at the point of delivery. Additionally, this SEIS is analyzing a short timeframe of the remainder of the interim period, through 2026. The total amount of lakebed exposure does not vary between the No Action Alternative and the Proposed Action in this SEIS. The SEIS Proposed Action and the No Action Alternative would result in the same level of lakebed exposure; the alternatives only vary in the rate of exposure. Topics mentioned by the commenter are being analyzed in separate NEPA efforts such as the USACE Salton Sea Management Program Phase I: 10-Year Plan EA and the IID 2024-2026 Temporary Colorado River System Water Conservation Project. For instance, the IID 2024-2026 Temporary Colorado River System Water Conservation Project EA will have resource analysis section on Biological Resources, Air Quality, Environmental Justice, and Human Health. Separate actions at the Salton Sea to address biological and public health issues are ongoing. The Salton Sea Management Program (SSMP) Phase 1: 10-Year Plan (2018-2028) identifies a goal to create 29,800 acres of aquatic habitat and dust suppression projects to improve conditions around the Salton Sea. To assist in implementation of the of the SSMP, the Department of Interior has authorized $250,000,000 to support and expedite the implementation of projects at the Salton Sea (December 2022). This funding is planned to expand the Species Conservation Habitat Project, adding up to 7,000 acres of aquatic restoration to the 4,100 acres already constructed at the project site. Please refer to the Annual Report on the Salton Sea Management Program (2023, CNRA) for more information related to on ongoing efforts and prior year accomplishments.
15	1	SCOPE - Scope of analysis	The plan to manage the water in the Colorado should include accounting for evaporation and system losses, in all 7 states. Without accounting for system loss, individual water users do not have an incentive to improve their systems, or to do so, they bear the full cost. Changing to more efficient irrigation systems, more efficient water transportation systems, more efficient water storage systems, more efficient ways to use water all require capital investments. An individual water user, with no accounting for loss, has little incentive to spend the money to improve their systems. The basin as a whole benefits, but the individual user sees little economic benefit. If evaporation and system loss are accounted for, though, then the individual user has an economic incentive to improve their system, and receives a direct benefit. Accounting for evaporation and system loss would also use the economic system to motivate people to make the cheapest beneficial improvements first. If an improvement is cheap and easy to do, users benefit from a quick return on investment. In areas where improvements are more expensive or harder to achieve, users might decide it is better to pay more for more water, or make other, cheaper, changes to use less water. Accounting for evaporation and system loss incentivizes improvements, and incentivizes the most cost-effective improvements. Including accounting for evaporation and system loss in this management plan would be best. If it cannot be included in this plan, it should be included as soon as possible.	Evaporation and system losses are outside the scope of this SEIS. For more information on this issue, see the report published by Reclamation in early 2024. The report presents methodologies that have been used to develop those datasets; however, it does not make recommendations on how to implement or account for system losses from the lower Colorado River mainstream.

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115	1	SCOPE - Scope of analysis	A continued, singular federal focus to address the serious water supply problems by only focusing on the mainstream Lower Basin water users is a failure of leadership at the highest levels of the Federal Government. Segregating the Federal Government's responsibilities into a singular focus on the Lower Basin states' water use under the Law of the River from Reclamation's legal obligations to tribal tributary water users in the Upper Basin under Indian reserved water rights law at this critical time in history continues the Federal Government's failures of the past that result in an unequal system and unequal treatment--such unequal treatment of our Tribe's Indian water rights in current policies and actions that are not only unjust, it is illegal.	The SEIS concerns operations at Lake Powell and Lake Mead. The tribes have a variety of water rights across the Basin with unique characteristics. A detailed discussion of these rights is not required unless it is related to operations within the scope of the SEIS. Some tribes may choose to participate in the voluntary system conservation opportunities described in the Proposed Action. Such participation is voluntary and does not affect any Tribe that does not want to voluntarily participate. The voluntary conservation would also increase reservoir levels compared with the No Action alternative, making mandatory shortages under the 2007 Interim Guidelines less likely.
115	2	SCOPE - Scope of analysis	The scope of Reclamation's Draft SEIS is much too narrow. Our Tribe is completely excluded from any evaluation, analysis, or consideration on the critical issues before Colorado River water users today. There is no impact analysis on our Tribe's Indian Trust Assets. The study area did not include our Reservation, people, or environment, nor did it include the counties that have a footprint within our Reservation. We understand that Reclamation is supplementing the 2007 Interim Guidelines for the operation of Glen Canyon and Hoover Dams and, with that focus, maintained the same 2007 study area, which begins at Lake Powell. However, numerous tribes provided comments and input to Reclamation about the problem with the agency's scope of study for the 2007 Interim Guidelines. The limited current scope for the SEIS is unresponsive to prior tribal input. [See comment letter for additional details.]	The scope of the SEIS remains appropriate as it is a supplement to the 2007 Interim Guidelines and concerns operations at Lake Powell and Lake Mead. Comments concerning expanding the scope after the expiration of the Guidelines should be addressed to the Post-2026 process. The environmental justice analysis area includes counties in the Basin that may be affected by management direction, resulting in water shortages or changes to water-based recreation. The counties where the Ute Indian Tribe of the Uintah and Ouray Reservation is located would not be affected.
116	4	SCOPE - Scope of analysis	as set forth in prior proposals, evaporation and transit losses should, as a general matter, be apportioned in the Lower Basin.	Evaporation and system losses are outside the scope of this SEIS. For more information on this issue, see the report published by Reclamation in early 2024. The report presents methodologies that have been used to develop those datasets; however, it does not make recommendations on how to implement or account for system losses from the lower Colorado River mainstream.
285	10	SCOPE - Scope of analysis	The scope of the SEIS should include the Colorado River and its tributaries from the full pool of the most upstream reservoirs affected by potential "Emergency Drought Response Operations Agreement" (DROA) releases. DROA releases alter inflows to Lake Powell. Although the draft SEIS states "Reclamation does not control the hydrology that affects inflows to Lake Powell" (p.1-12), Reclamation in fact did, under DROA, release almost 700,000 acre-feet from upstream reservoirs from 2021-22 (p. 1-6), affecting inflows to Lake Powell. In June 2022, Commissioner Touton testified before the U.S. Senate Committee on Energy and Natural Resources and called on water users across the Basin to take actions to prevent the reservoirs from falling to critically low elevations. Interior officials have noted that "Every sector in every state has a responsibility to ensure that water is used with maximum efficiency." The magnitude of the current and expected future decrease in Colorado River flows demands action from water users across the basin, as well as a departure from "routine dam operations.	The geographic scope of this SEIS matches that of the 2007 EIS it is supplementing. DROA releases and their impacts are not within the scope of this SEIS.

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290	2	SCOPE - Scope of analysis	Based on the "Revised Draft Supplemental Environmental Impact Statement" (SEIS) and exclusion of the Salton Sea from consideration, without a solid argument in support of such decision, it is obvious that Bureau of Reclamation (BoR) succumbed under pressure of those who promote destruction of the Salton Sea. In this case the BoR failed to fulfil its own mission statement. The BoR must review the situation of the Salton Sea independently especially after receiving verifiable information of wrongdoing (manipulative conducts) of several agencies and threat of incoming ecological disaster with serious consequences if the "current course of action" continues. I am copy/paste several segments from the SEIS - only on the issues relevant to the Salton Sea and will comment on them.	Reclamation has performed an appropriate review of the Salton Sea considerations for this SEIS. See Chapter 3 Section 3.5.2 and cumulative impacts analysis in individual resource sections. Independent review of the Salton Sea is outside the scope of this SEIS.
290	29	SCOPE - Scope of analysis	6.3 Although it should be standard practice by the Federal and State officials before issuing funding for any project, in this case, I am respectfully requesting, because I am deeply involved in this case and because state's interest and liability is involved, that the State (officials in charge of delivering the funding) ask applicants (the local leadership) the following questions and request solid answers (not vague ones such as "we will check on it later" or "we are working on it" and alike). It is important to point out that local leaders have been working (participating) on design for the restoration of the Salton Sea already for over 20 years and come up with non-functional long-term solution. 6.4 The Questions that should be asked are: 6.4.1 (a) What is the functional purpose of the "Pilot Project Lake" if there is any? 6.4.2 (b) If there is none, then why proceed with the "Pilot Project Lake"? 6.4.3 (c) Where exactly water will be supplied from for the "Pilot Project Lake" and accountability for it? 6.4.4 (d) Where exactly water will be supplied from for the "North Lake" project and accountability for it? 6.4.5 (e) Who will lose the water that will be used for the "Pilot Project Lake"? 6.4.6 (f) How will the "Pilot Project Lake" fit in whole project for the restoration of the Salton Sea? 6.4.7 (g) Will dike (barrier) that form the "Pilot Project Lake" be dismantled after local leaders' supposedly find what the quality of the water will be or will dike (barrier) stay there permanently as an obstacle to the water flow when real functional solution is going to be implemented? 6.4.8 (h) To provide dated blueprint of their plan - illustrations with water level (elevation) in the "Pilot Project Lake" and water level (elevation) in the "North Lake", and water level (elevation) in Central part of the Salton Sea where their "Brine Lake" will be? 6.4.9 (i) Since the Salton Sea is relatively shallow lake, the difference in water level (elevation) between body of water (Pilot Project, North Lake, and Brine Lake) increases the surface of exposed lakebed (playa) - the distance between those bodies of water - What they intend to do with exposed lakebed (playa) formed between the "Pilot Project Lake" and "North Lake" and between the "North Lake" and "Brine Lake" according to their design? 6.4.10 (j) Are they infringing anyone's patent rights, partially or wholly, by proceeding with "their" "North Lake" "design"? 6.4.11 (k) If so, do they intend to transfer liability for their mistakes (illegal conduct) to the State and Federal governments? Those questions above are relative to the "Pilot Project Lake". Since "local leaders" does not want to answer to me any of my questions posed to them, I am respectfully requesting that federal and state officials ask the "local leaders" and request straight answer on the following questions before delivering the check of $19.25 million, because the questions are of great importance and answer on those question will help understand the situation	Management related to the Salton Sea is not within the scope of this SEIS.

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290 *(cont.)*	29 *(cont.)*	SCOPE - Scope of analysis *(cont.)*	which is in interest to State and all stakeholders. Also, the State needs to be extra aware of the answer to question (k) (6.4.11) above. My statements (claims) are extraordinary and should be challenged but have not been challenged either by local leaders or by the State or BoR. 6.5 The second set of challenging question are: 6.5.1 When I say: "with the implementation of my proposal for the restoration of the Salton Sea, we could generate revenue at least about $500,000,000 per year just from clean renewable energy". That should be challenged with the question: "How that could be done?" If needed debate and rossexamination questions should be allowed and welcomed. If local leaders prefer not to have revenue for the community (stakeholders) of at least about $500,000,000 per year just from clean renewable energy, then, they need to write reasoning for such decisions. 6.5.2 When I say: "With the implementation of my proposal for the restoration of the Salton Sea, we could fill up the Lake to the water level of the 1950's and 60's and restore original beaches and marines despite lessen water inflow from Colorado River". That should be challenged with the question: How that could be done?- If needed debate and cross-examination questions should be allowed and welcomed. If local leaders prefer not to have restored the Salton Sea to glory of the 1950's and 60's, then, they need to write reasoning for such decisions. 6.5.3 When I say: "With the implementation of my proposal for the restoration of the Salton Sea, we could import seawater from Gulf of California (Sea of Cotez) and save about $100,000,000 per year". That should be challenged with the question: How that could be done?- If needed debate and cross-examination questions should be allowed and welcomed. If local leaders prefer not to save $100,000,000 per year, then, they need to write reasoning for such decisions. 6.5.4 When I say: "With the implementation of my proposal for the restoration of the Salton Sea, we could put the Salton Sea on the World Map as a tourist destination". That should be challenged with the question: How that could be done?- If needed debate and cross-examination questions should be allowed and welcomed. If local leaders prefer not to have the Salton Sea on the World Map as a tourist destination, then, they need to write reasoning for such decisions. 6.5.5 When I say: "With the implementation of my proposal for the restoration of the Salton Sea, we could have constant production of lithium of about 1,000 - 750 tons per year from imported seawater". That should be challenged with the question: How that could be done?- If needed debate and cross-examination questions should be allowed and welcomed. If local leaders prefer not to have about 1,000 tons of lithium per year from imported seawater, then, they need to write reasoning for such decisions. 6.5.6 When I say: "With the implementation of my proposal for the restoration of the Salton Sea, we could have several recreational parks with small lakes with nearby fisheries on industrial scale without additional water for it". That should be challenged with the question: How that could be done?- If needed debate and cross-examination questions should be allowed and welcomed. If local leaders prefer not to have several recreational parks with nearby fisheries on an industrial scale, then, they need to write reasoning for such decisions. 6.5.7 When I say: "With the implementation of my proposal for the restoration of the Salton Sea, we could have the Salton Sea as a hub for production of potable water". That should be challenged with the question: How that could be done?- If needed debate and cross-examination questions should be allowed and welcomed. If local leaders prefer not to have the Salton Sea as a hub for production of potable water, then,	*(See above.)*

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290 *(cont.)*	29 *(cont.)*	SCOPE - Scope of analysis *(cont.)*	they need to write reasoning for such decisions. 6.5.8 When I say: "With the implementation of my proposal for the restoration of the Salton Sea, we could harness geothermal energy, which is prevalent in the area, with no limitation to geothermal reservoir"-meaning, we could harness much more geothermal energy than estimated with conventional systems. That should be challenged with the question: How that could be done?- If needed debate and cross-examination questions should be allowed and welcomed. If local leaders prefer not to harness much more geothermal energy than estimated with conventional systems, then, they need to write reasoning for such decisions. Brushing off those claims above in 6.4 - 6.4.11 and 6.5 - 6.5.8 and avoiding challenges and open discussions proves arrogance, ignorance, naiveness, and incompetence by local and some state officials. Also, it indicates an anticipation of illegal conduct as I mentioned in segments 3.4.1 and 4.4.1. 6.6 As I explained in many of my public comments, I will repeat it again. There are really two options for the State and Federal governments to choose about the fate of the Salton Sea with two completely different outcomes: 6.6.1 Option I - To proceed with the current project already in motion the "North Lake Pilot Demonstration Project" which is part the "Smaller, Sustainable Lake" "10-year plan" "Perimeter/Brane Lake" - The projects that will be constantly asking the State and Federal Governments for help (for more money) for fixing never-ending problems - and at the end losing the Lake with tremendous liabilities in billions of dollars (environmental disaster - toxic dust storms, health issues, and economic fold). NOTE: In the process would benefit a few "friendly" companies on the expenses of the environment and communities; and 6.6.2 Option II - Based on new revealing critical information, redirecting efforts and allocated money toward implementation of the long-term solution (my proposal) which would restore the Salton Sea to the water level of the 1950s and 60s; provide the condition for tourism, wildlife sanctuary, clean environment, and generate revenue in 100s Billion Dollars in several decades and would continue so in the future costing only about $15,000,000,000. NOTE: A few companies that would benefit from Option (I), would benefit even more with Option (II).... That is the absurdity of the current situation (See section 4.5). 6.7 Since the check of $19.25 million is delivered, according to the article and video, it appears that my numerous public comments in which I exposed faultiness of the "current course of action" did not make any effect, and because disconnect between local leaders (members of the SSA) and top State and Federal officials exist, I am contacting BoR again directly, for the record, urging you to inform Secretary Wade Crowfoot and Governor Gavin Newsom to stop nonsensical projects and start working towards the restoration of the Salton Sea - option (II) above 6.6.2. Because the local leaders "members of the Salton Sea Authority" are not functioning properly - they are not working in the interest to the Salton Sea and nearby communities as originally intended at their formation in 1993, - therefore honorable top state and federal officials must use its power to save and restore the Salton Sea and enforce the fundamental State's and Federal's policies regarding the Environmental Law. Based on attitude and the record, it is obvious that "local leaders" will not change their intentions unless they must. 6.8 The absurdity of this case is that I am defending fundamental policy of the State and Federal governments against "local leaders" and agencies that the State and Federal governments keep funding.	*(See above.)*

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294	7	SCOPE - Scope of analysis	2. In the alternative, the FRWC requests Reclamation to include prior Alternatives 1 and 2 in the final supplemental EIS and reevaluate Alternatives 1 and 2 and the proposed action to consider the benefits of additional shortages in 2023 across the alternatives. It does not appear that the additional shortages proposed for 2024 in Alternatives 1 and 2 was included in the modeling completed for the Revised SEIS. In contrast, the additional conservation of 750,000 ac-ft per year for the proposed action is included starting in 2023 and continuing through 2026. As a result, the comparison of model results for the proposed action with results for Alternatives 1 and 2 is misleading as the proposed action performs better with respect to elevations at Lake Powell and Lake Mead due to the additional shortages included in that alternative in 2023 and 2024. To provide a valid comparison of the alternatives, Reclamation should reevaluate Alternatives 1 and 2 by including additional shortages of up to a maximum of 2,083,000 ac-ft in 2024 and compare with the proposed action. The maximum volume of shortages analyzed in the 2007 FEIS was 2,083,000 ac-ft.	The analysis showed that the Proposed Action balances risks between Lake Powell and Lake Mead better than the operational tiers considered in Action Alternatives 1 and 2, as demonstrated in the graph on p. 2 of the Dear Reader Letter to the Revised Draft SEIS. Action Alternatives 1 and 2 were therefore moved to the alternatives considered but eliminated from detailed analysis section. In addition, the ability to reduce Lake Powell releases to 6.0 maf, the Secretary's ongoing reserved authority to take emergency actions, and the SEIS conservation in the Lower Basin states, do show that the system is more protected than under the No Action Alternative as well as Action Alternatives 1 and 2 from the Original Draft SEIS.
297	14	SCOPE - Scope of analysis	The SEIS analysis of affected environment and environmental consequences is deeply flawed and misleading, especially regarding emerging ecological, cultural, and recreational resources in Glen Canyon, Cataract Canyon, Narrow Canyon, and the San Juan River. [...] The DSEIS should have recognized and included an analysis of the importance of the emerging recreational resources in the tributary rivers and canyons, including rafting and hiking in Glen Canyon, and recognize the impact that operational strategies will impact environmental resources including vegetation, wildlife, and archeological/cultural sites in Glen Canyon.	Section 3.14 discusses emerging recreational resources in Glen Canyon. Section 3.11 discusses archaeological resources in Glen Canyon. Section 3.13 discusses emerging vegetation and wildlife habitat in Glen Canyon.
297	44	SCOPE - Scope of analysis	An accounting approach that prioritizes water storage in Lake Mead could offer flexibility to the system, encourage conservation in the Upper Basin, and may save 30,000-50,000 acre feet a year by avoiding higher ground-seepage rates in Glen Canyon68. Though such an idea was considered outside the scope of previous NEPA analyses, it is now essential to look at as one of the potential options considering the current and anticipated hydrology of the Colorado River. Analyzing options for Upper Basin storage in Lake Mead in the SEIS process would have provided all stakeholders in the Basin the information needed to assess the best approach to water storage in the decades ahead.	As stated in Section 2.8.3, using Lake Powell as a backup for seasonal and flood control purposes to meet the goals of reducing evaporation and seepage and increasing flexibility for implementing Grand Canyon restoration strategies. This alternative would not meet the federal action's purpose (which focuses on the critically low elevations impacting operations of both Glen Canyon and Hoover Dams during the interim period [prior to January 1, 2027]), and need (which is based on the potential that continued low-runoff conditions in the Basin could lead Lake Powell and Lake Mead to decline to critically low elevations, which would impact operations through the remainder of the interim period).
306	5	SCOPE - Scope of analysis	Pp. 3-1, 2: Why is Grand Canyon, the world's most famous national park, not included in the discussion of project areas affected by the decision?	The Grand Canyon is within the geographical scope discussed in Section 3.2. Analysis of impacts to the Grand Canyon are provided in relevant resource sections, including 3.13.2 for impacts to vegetation and wildlife and 3.14.2 for impacts to recreation.

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310	3	SCOPE - Scope of analysis	The "cruel arithmetic" is unambiguous; the Colorado River is overallocated, and we must face that reality. The Sierra Club supports fully accounting for the estimated "1.5 million acre-feet of water lost to evaporation, transportation, and inefficiencies each year in Arizona, Nevada, and California '' (Naishadam 2023). We join the Arizona Municipal Water Users Association (Tenney 2022) in principle in "Section V. Evaporation and System Loss" of their letter, calling for Colorado River water users to bear a proportional reduction for water loss caused by evaporation, seepage, and other losses before, during, and after water delivery to a water user. We were disappointed to see that Reclamation did not even propose using losses from evaporation and seepage and other causes as an alternative in the RDSEIS or make it part of any existing alternatives, especially after Reclamation indicated it would be moving in the direction of assessing water users for such losses as a means of conservation. The burden of this recognition of water lost in delivery to and use by water users would fall proportionally on all users in all states. This seems to us one of the fairest ways to share recognition of water use that should have been recognized long ago. Reclamation must include such an alternative or condition in arriving at the Preferred Alternative for the Final RSEIS and include proportional user accountability for water losses.2	Evaporation and system losses are outside the scope of this SEIS. For more information on this issue, see the report published by Reclamation in early 2024. The report presents methodologies that have been used to develop those datasets; however, it does not make recommendations on how to implement or account for system losses from the lower Colorado River mainstream.
310	8	SCOPE - Scope of analysis	The RDSEIS has failed to fully analyze operations. impacts on natural resources, including biodiversity and ecosystems in areas that are outside of the river basin but receive its water (e.g., coastal southern California and coastal northern Baja California) These areas should be included in the analysis.	This SEIS is analyzing impacts at the point of delivery. Impacts beyond this point are too speculative to include in this short-term NEPA analysis. Where specific resources are affected outside the defined geographic scope, and those effects are capable of being meaningfully analyzed, expanded analysis areas are defined in the applicable section of Chapter 3 in the SEIS.

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310	19	SCOPE - Scope of analysis	On a broader scale, the RDSEIS is weakened by not including Mexico's plans for Colorado River water management in its geographic scope (RDSEIS, p. 2-24). While we recognize that Reclamation excludes Mexico from the RDSEIS geographically as well as the impacts of water management actions in the United States on Mexico for legal-political reasons, failing to include impacts of the two alternatives on the whole of the Colorado River Basin makes the RDSEIS much less useful to reviewers. Our understanding is that Executive Order 12114 ("Environmental effects abroad of major Federal actions") may apply, in particular, Section 2.3(d): major Federal actions outside the United States, its territories and possessions which significantly affect natural or ecological resources of global importance designated for protection under this subsection by the President, or, in the case of such a resource protected by international agreement binding on the United States, by the Secretary of State. Recommendations to the President under this subsection shall be accompanied by the views of the Council on Environmental Quality and the Secretary of State. The Upper Gulf of California and Delta of the Colorado River Biosphere Reserve is a UNESCO World Heritage Site and also a protected wetland area designated under the Ramsar agreement (González Barajas 2021, Ramsar n.d.). This area includes the Ciénega de Santa Clara (Santa Clara Slough), which is fed water by a canal that originates in the Wellton-Mohawk Irrigation and Drainage District in the United States, so any effects on Colorado River flows to Wellton-Mohawk could well have an effect on water flows to the Ciénega de Santa Clara, and operation of the desalination plant in Yuma County would have a very direct and adverse effect on the Ciénega de Santa Clara. However, these possible effects of the proposed and cumulative actions are not analyzed in the RDSEIS.	Subject to the relevant provisions of the 1994 Water Treaty with Mexico and its implementing Minutes, Mexico has sovereign decision-making over its allotment of water from the Colorado River System. The scope of this SEIS is limited to domestic actions within the United States. Coordination on implementation of the 1944 Water Treaty is carried out by the U.S. Section of the International Boundary and Water Commission. Nothing in this SEIS modifies in any manner Mexico's authorities and rights under the 1944 Water Treaty.
310	25	SCOPE - Scope of analysis	Implementation of the RDSEIS's Proposed Action will not eliminate the risk of reaching dead pool in Lake Mead nor of falling below the minimum power pool at Glen Canyon Dam (RDSEIS p. 1-7). The Bureau should consider at what point river management specifically, "water and power needs" would be better served by maximizing water storage in Lake Mead rather than dividing storage between Mead and Powell reservoirs. The Bureau should assess the comparative loss of water (1) to infiltration and (2) from evaporation between maintaining both reservoirs, maintaining only Lake Mead, and an alternative where Lake Powell is kept low to reduce losses to infiltration and evaporation. Hydropower needs may be more secure if water is concentrated above Hoover Dam, where it will have a higher hydraulic head.	Reclamation has considered the concepts recommended by the commentor but eliminated them from detailed analysis as outlined in Section 2.8.
310	27	SCOPE - Scope of analysis	Reclamation needs to immediately begin studies to develop new ways to pass water around Glen Canyon Dam under low reservoir conditions. Examining the potential to construct river outlets with low intakes on Glen Canyon Dam would enable Reclamation to keep the Lake Powell reservoir low without risking dead pool above Glen Canyon Dam.	Thank you for your comment. Reclamation is exploring options to address these issues. However, the suggested action is outside the scope of this SEIS.

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310	28	SCOPE - Scope of analysis	Because Lake Powell is likely to fluctuate around its current level into the future, continuing the risk of allowing more warm water non-native fish in the Grand Canyon, Reclamation should also examine the potential for other dam modifications that will limit fish passage through the dam. One possibility is upstream screening. Because it will take some time to analyze the feasibility of this action, Reclamation should begin to study it now.	Thank you for your comment. Reclamation is exploring options to address these issues. However, the suggested action is outside the scope of this SEIS.
310	29	SCOPE - Scope of analysis	During Reclamation's webinar on its future Glen Canyon Dam Low-Head Hydropower Modifications project, Reclamation acknowledged that implementation of major dam modifications will not occur for at least a decade. Analysis and planning must begin immediately to avoid severe damage to the Colorado River ecosystem in the Grand Canyon, should dead pool occur above Glen Canyon Dam. Glen Canyon Dam modifications will also increase flexibility to control water temperature in the Grand Canyon, as proposed in the Glen Canyon Dam/Smallmouth Bass Flow Options Draft Environmental Assessment. Recommendation 5: As part of or simultaneously with this process, Reclamation needs immediately to begin to plan a way to move water around the dam at the base of Glen Canyon Dam. This will: 1) maintain flow through the Grand Canyon and enable reliable water deliveries by eliminating the possibility of reaching dead pool, 2) enable water to be concentrated above Hoover Dam while maintaining the flexibility to move water downstream from a low Powell reservoir, and 3) allow cold water to be released from the deepest part of the reservoir, even when reservoir levels are low.	Thank you for your comment. Reclamation is exploring options to address these issues. However, the suggested action is outside the scope of this SEIS.
310	30	SCOPE - Scope of analysis	Recommendation 6: Assess the comparative loss of water from bank storage and evaporation between maintaining both reservoirs, maintaining only Lake Mead, and an alternative where Lake Powell is kept low to reduce losses to infiltration and evaporation. Recommendation 7: As part of or simultaneously with this process, Reclamation should implement screening upstream of Glen Canyon Dam to prevent future non-native species passage through the dam.	Thank you for your comment. Reclamation is exploring options to address these issues. Reclamation has considered Recommendation 6 from the commentor but eliminated them from detailed analysis as outlined in Section 2.8. Recommendation 7 is outside the scope of this SEIS.
314	2	SCOPE - Scope of analysis	It is important for evaporation, seepage, and system losses to be incorporated into this SEIS analysis and not in a separate report. Despite improved hydrology from water year 2023 and commitments to Lower Basin conservation, continuing to ignore real losses from evaporation, reservoir operators have the potential to lower Lake Powell elevations faster than projected. This SEIS analysis is not looking into the broader scope of potential future scenarios that include drastically reduced hydrology and hydrology that isn't supported by the engineering realities of basin infrastructure, importantly, Glen Canyon Dam. The SEIS needs to be informed by the latest science and data now to set all basin stakeholders up for success beyond the planning horizon of this NEPA process.	Evaporation and system losses are outside the scope of this SEIS, which covers the remainder of the interim period, through 2026. For more information on this issue, see the report published by Reclamation in early 2024. The report presents methodologies that have been used to develop those datasets; however, it does not make recommendations on how to implement or account for system losses from the lower Colorado River mainstream.

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314	3	SCOPE - Scope of analysis	Both the No Action Alternative and the Proposed Action Alternative need to thoroughly analyze the operational and drought effects on recreation and the environment throughout the whole project area. The geographic scope of the Draft SEIS includes from full pool Lake Powell to the Southerly International Boundary. This boundary includes over 30 miles of the Cataract Canyon whitewater reach and over 60 miles on the San Juan River downstream from Grand Gulch. Additionally, there is a 30-mile reach below Hoover Dam through the Black Canyon Water Trail that is supported by releases out of Hoover Dam. All three of these river recreation opportunities need to be analyzed and managed for in the SEIS in addition to considerations of recreation within the Grand Canyon in addition to considerations of recreation within the Grand Canyon. The acknowledgement of whitewater boating as a key recreational activity is important, but it needs to be fully assessed within the entire geographic scope of the SEIS.	Thank you for your comment. Cataract Canyon and the San Juan River are beyond the geographic scope of the analysis. Boating opportunities below Hoover Dam are already analyzed. No changes have been made to the document.
317	1	SCOPE - Scope of analysis	Yuma is concerned that the RDSEIS assessment fails to address one of the most negatively impactful activities affecting the Colorado River system, an activity that is currently being supported by the Bureau of Reclamation (BOR). Yuma requests that BOR reconsider its current policy determinations and future decisions for off-river and out-of-basin water transfers for Colorado River waters. Off-river water transfers are diminishing the Colorado River system of its resources. And the transfers from rural communities to more affluent metropolitan communities disparately impact rural residents and rural economic opportunites. Yuma urges BOR to provide an injunction to future off-river water transfers of Colorado River water and institute a stay for future water transfer application until the Colorado River system is capable of fulfilling its current water allocation commitments in-turn. It is known as the Colorado River is overallocated and to prevent perpetuating an already insolvent system, BOR should not support additional unused uses of the Colorado River. BOR river operational guidelines and plans, including the modeling and forecasted demands within the RDSEIS, are reflective of current steady-state water usages and in-basin water hydrologic interconnections.	Thank you for your comment.

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317	2	SCOPE - Scope of analysis	Any river operational plan, including the RDSEIS, should address the adverse impacts of out-of-basin and off-river water transfers, including: - Permanently transferring water off-river and out-of-basin reduces the amount of wet water in the river system that is the sole source of supply for many on-river communities. It also reduces the effectiveness of water management tools, such as return flow and effluent creation and storage for on-river municipalities to respond to future river shortages. - Disproportionate socio-economic impacts. It is reasonably foreseeable that permanently transferring water will deprive agriculturally dependent communities of critical economic opportunities for already lower income and oftentimes minority residents. Decreased agricultural activity will also increase air pollution from dust and exposure to airborne contaminants. - Environmental impacts on national wildlife refuges and special status species dependent on River flows and quality. On-river communities rely on the health of the river to sustain unique ecological resources that support local environmental tourism. Permanently transferring river water away from downstream stretches of river will impair these unique, protected resources, such as the Yuma Clapper Rail, Native Bonytail Fish, Razorback Sucker, and Southwestern Flycatcher. - Decreased water supply reliability has impacts at the local, state, and the federal level. Wide-ranging regulatory impacts include the State of Arizona's decreased flexibility to respond to river shortages due to wet water leaving on-river reservoirs, diminished ability to participate in land fallowing programs to meet water use reductions, reduced ability to create system conserved water, and related effects on the development of federal and inter-state regulatory plans that would otherwise account for transferred water remaining on-river.	Thank you for your comment.
484	14	SCOPE - Scope of analysis	The Revised Draft SEIS includes a statement under Section 2.8.5 that "[w]hile Reclamation has not carried forward an alternative that focuses explicitly on accounting for evaporation, seepage, and system losses, the Proposed Action contemplates conservation amounts similar to those that would be assessed based on evaporation, seepage, and system loss calculations in the proposals received." In this Revised Draft SEIS, Reclamation may not have considered the full range of impacts and risks to the system, due to the lack of explicit reporting and accounting of evaporation and losses, and the lack of consumptive uses and losses reporting for the Lower Basin. The Notice of Intent for the SEIS included a statement that Reclamation would consider accounting of evaporation and system losses in parallel with this effort. Like the First Draft SEIS, the Revised Draft SEIS includes a statement that Reclamation intends to publish in 2023 an informational report addressing potential methodologies to support assessments for evaporation and other system losses in the Basin. 2023 is almost over and this report has yet to be published. Information on this topic is an essential part of the SEIS analysis that is missing.	Evaporation and system losses are outside the scope of this SEIS, as described in Section 2.8.5. For more information on this issue, see the report published by Reclamation in early 2024. The report presents methodologies that have been used to develop those datasets; however, it does not make recommendations on how to implement or account for system losses from the lower Colorado River mainstream.

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117	3	SOCIO - Socioeconomics	No Action puts NPS unit resources and regional economics at risk - This draft analysis shows that the consequences of No Action would have major impacts on resources and recreation at several iconic national park units including Grand Canyon National Park (GCNP), Glen Canyon National Recreation Area (GCNRA), Lake Mead National Recreation Area (LMNRA), Rainbow Bridge National Monument, and Canyonlands National Park. These park units make up over 4,282,416 acres, seven times larger than the acreage of the state of Rhode Island. These park units are visited by over 18 million visitors annually and a large proportion of that visitation could be negatively impacted by No Action. In years with very low inflow into Lake Powell and overall poor hydrology, there may be lower releases from Glen Canyon Dam that may negatively impact river rafting recreation in GCNP. In LMNRA and GCNRA, allowing reservoir levels to continue to decline would make boat ramps and marina services partially or completely unavailable. As shown in Table A-1 below, the combined visitor spending at these three large park units was over $1.4 billion in 2021, and the regional economic output was over $1.8 billion. The loss of recreation would have a significant effect on the revenues of GCNRA and LMNRA due to declines in entry and camping fees, as well as concessions and commercial use fees. The economies of surrounding communities would also be significantly impacted from loss of visitor spending.	Thank you for your comment- the SEIS includes baseline data on the importance of water based on recreation for the regional economy (see for example, Table 3-92, with the total economic contributions from recreation occurring in the GCNRA, LMNRA, and GCNP). In addition, the economic analysis acknowledges the potential for economic impacts to the recreation sector and regional economy as a result of reservoir level changes. Insufficient information is available on specific changes to recreation visitation levels to provide input data for quantitative recreation contribution analysis by alternative.
138	6	SOCIO - Socioeconomics	BOR should analyze the full impact of recreation opportunities with releases and experimental flows. When developing future plans potential economic loss needs to be considered. In 2022 GCNRA economic output was $372,677,000.1 That is more than $7 million per week. Lake Mead's economic output was $343,000,000 which is $6.5 million per week. The Bureau of Reclamation needs to consider the full impact of water levels and releases on the economy when selecting an alternative and making a decision. Not cutting 3maf would greatly harm not only local economies but would have a ripple effect in the nation's economy.	The SEIS includes baseline data on the importance of water-based recreation for the regional economy (see for example, Table 3-92, with the total economic contributions from recreation occurring in the GCNRA, LMNRA, and GCNP). In addition, the economic analysis acknowledges the potential for economic impacts to the recreation sector and regional economy as a result of reservoir level changes. Insufficient information is available on specific changes to recreation visitation levels to provide input data for quantitative recreation contribution analysis by alternative.

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138	7	SOCIO - Socioeconomics	The low water years at Lake Powell and Lake Mead were nothing short of a wipeout that cost their local economies over $300 million in two years. We now know that the low-water levels cost the area surrounding Lake Powell and Lake Mead hundreds of millions of dollars in direct economic benefit. In 2022, Glen Canyon NRA showed a $207 million dollar decline. Lake Mead also saw a $114 million dollar decline in 2022. Those numbers are big enough they should be factored into this decision. Releases that cause lake levels to drop for an extra week or two cost local communities millions of dollars. Its economic multiplier is 10, giving rise to over $4 billion in direct economic value to its surrounding and regional areas. The low water years at Lake Powell and Lake Mead were nothing short of a wipeout that cost their local economies over $300 million in two years. We now know that the low-water levels cost the area surrounding Lake Powell and Lake Mead hundreds of millions of dollars in direct economic benefit. In 2022, Glen Canyon NRA showed a $207 million dollar decline. Lake Mead also saw a $114 million dollar decline in 2022. Those numbers are big enough they should be factored into this decision. In 2019 both GCNRA and Lake Mead generated more economic output confirming that higher water levels support economies. GCNRA and Lake Mead alone provide over 6,000 jobs. According to the Bureau of Economic Analysis, outdoor recreation boosted the economy by $1.08 trillion in 2022. "Boating/fishing was the second-largest conventional activity for the nation at $32.4 billion"	The SEIS includes baseline data on the importance of water-based recreation for the regional economy (see for example, Table 3-92, with the total economic contributions from recreation occurring in the GCNRA, LMNRA, and GCNP). In addition, the economic analysis acknowledges the potential for economic impacts to the recreation sector and regional economy as a result of reservoir level changes. Insufficient information is available on specific changes to recreation visitation levels to provide input data for quantitative recreation contribution analysis by alternative.
282	4	SOCIO - Socioeconomics	Comment 4: Page 3-261, The sentence: For example, the total difference in economic value under typical hydrologic conditions shows the No Action Alternative outperforming the Proposed Action by $8,554,000; this would only be a 4.8 percent decrease in the annual revenue from the SLCA/IP annual revenue from 2021 (WAPA, 2021). Please delete the underlined portion of the sentence as it is inaccurate to say that these changes would result in less revenue, and in this manner. Since CRSP must meet its revenue requirements, this would potentially have rate impacts but would not reduce the revenue, and even if it did affect the rate those values are financial and not these economic values provided. Thus, delete the underlined portion. [See comment letter, underlined is the last portion of the sentence after the semicolon]	Deleted language per comment.
284	9	SOCIO - Socioeconomics	Second, the RDSEIS analyzes the impact of seasonal fallowing through a model that assumes that the least profitable crop would be fallowed first. See RDSEIS at 3-294. That model does not approximate real-world conditions because less-profitable crops are used in some areas as rotation crops to promote soil health necessary to support more valuable crops in other growing seasons. In such areas, it would be more accurate to assume that crops of average value are lost (corresponding to an arrangement where some land is taken out of production entirely). The existing analysis does not satisfy NEPA and does not support imposing any involuntary fallowing program upon these areas.	The section 3.16.2 impacts analysis of the alternatives acknowledges that it is difficult to project exactly how individual farmers, irrigation districts, or each Lower Division State may respond to shortages. Reclamation's approach for this SEIS was consistent with that used in the EIS, which provides a framework for the decision maker to compare the potential impacts across alternatives during the remainder of the planning period. This SEIS provides a disclosure of impacts as a result of potential courses of action. Fallowing is one such impact and this SEIS does not impose any involuntary fallowing program.

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295	12	SOCIO - Socioeconomics	Paying water utilities hundreds of millions of dollars at a cost of $500-$750 per acre foot to not use water for irrigation is a failed policy because the benefits are ephemeral, the growers get the financial benefits - not the farmworkers -- compounding the major water subsidy issue at numerous utilities. Many utilities like Palo Verde Irrigation District, Imperial Irrigation District and others are only charging growers $0 to $20 an acre-foot respectively, so fallowing programs with short term conservation benefits result in enormous economic benefits for growers that aren't shared with farmworkers that lost jobs due to fallowing.	Thank you for your comment- the potential impacts from system conservation payments on the regional economy is noted in the analysis (see section 3.16.2, discussion under Issue 1: How would anticipated water shortages affect economic contributions from agriculture?)
299	2	SOCIO - Socioeconomics	Acknowledgement of socioeconomic justice impacts: The revised draft acknowledges the potential for socioeconomic impacts from increased system conservation, and notes there is insufficient data to determine if proposed funding for this conservation would adequately address such impacts. Using the QSA as a model, Reclamation should consider the need for specific socioeconomic funding to support the potential impacts caused by voluntary decreased water use.	Reclamation is providing funding for compensated conservation on a voluntary basis to water entitlement holders, who will determine what to do with the funding and whether to create any socioeconomic fund with it. In the past, non-Federal parties to water conservation agreements have established such community funds; however, Reclamation does not establish or administer these funds.
324	1	SOCIO - Socioeconomics	NAR urges the selection of the Lower Division Proposal, which will require stakeholders to enact modest and limited actions related to water conservation and efficiency. NAR believes that a water conservation approach is important for several reasons, including environmental, economic, and social factors, as described in the comments. Water is a finite resource that is essential for life and a multitude of human activities, ranging from agriculture and industry to domestic use. However, with growing populations, urbanization, and changing climate patterns, water scarcity has become a national concern, particularly in the South and Southwest. It is imperative that we take proactive steps to ensure the efficient use of water and the preservation of this precious resource. Eleven percent of the country's water resources are used for residential and commercial property. Lack of adequate water resources can have far-reaching impacts on real estate markets. New housing and commercial developments are dependent on having sufficient water resources and more attention is now being paid to implementing water efficiency best practices in new and existing residential and commercial property that save water and decrease utility costs. The Colorado River Basin (Basin) provides essential water supplies to approximately 40 million people in 7 states, nearly 5.5 million acres of agricultural lands, hydroelectric renewable power, recreational opportunities, habitat for ecological resources, and other benefits across the southwestern United States and northwestern Mexico. However, this once-bountiful water supply is running into a perfect storm of unsustainability, with far reaching implications for future users: increased energy demand, increased population and long- term systemic changes in climate that have contributed to the region's worst mega-drought in 1,200 years. This year, the two largest reservoirs in the US, Lake Mead and Lake Powell, saw water levels dip to record lows. In turn, the Hoover Dam and the Glen Canyon Dam that impound these reservoirs saw their hydroelectric power production dwindle. The purpose of the RDSEIS is to evaluate how to reduce water uses across the American Southwest to avoid a water supply crisis on the Colorado River. Existing shortage rules are set to expire at the end of 2025, and a substantial re-evaluation and revision of Colorado River management is expected at that time. In the near-term, the current federal proposal is focused only on 2024-2026 because of the very real prospect of a crisis unfolding in the	Thank you for your comment. The purpose and need of this SEIS is to specifically to address the low reservoir conditions at Lake Powell and Lake Mead for the short-term planning period through 2026. Additional long term considerations related to changes on the river and on the places, people, and real estate markets that depend on it can be addressed in the post 2026 Colorado river EIS planning process.

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324 *(cont.)*	1 *(cont.)*	SOCIO – Socioeconomics *(cont.)*	next few years. The question before Bureau now whether the federal government will proceed with developing these short-term rules as set forth in the RDSEIS or whether the states that share the Colorado River will propose a different set of water use reductions going forward. The Revised DSEIS assesses two Action Alternatives. The No Action Alternative, required by the National Environmental Policy Act, preserves the status quo and describes the continued implementation of existing agreements that control Glen Canyon and Hoover Dams. The Proposed Action ("Lower Division Proposal"), models change to operations for both Glen Canyon Dam and Hoover Dam. The Proposed Action includes assumptions for conservation actions through 2026 with a minimum of 1.5 million acre-feet physically conserved by the end of calendar year 2024. Under the Proposed Action, tier-based reductions and contributions shall be limited to the existing 2007 Guidelines and other agreements. NAR Urges Selection of Lower Division Proposal NAR believes that a water conservation approach is important for several reasons, and its significance is highlighted by various environmental, economic, and social factors, including: Environmental Sustainability: Conserving water helps maintain the health of ecosystems and biodiversity. Many aquatic habitats depend on specific water levels and flow rates. Resource Scarcity: Despite the Earth's abundance of water, only a small percentage is suitable for human consumption. As the global population grows and water demands increase, the availability of freshwater becomes more limited. Conserving water ensures a sustainable supply for current and future generations. Energy Efficiency: Water treatment and distribution require a significant amount of energy. By using water more efficiently, the energy needed for pumping, treating, and heating water is reduced. This helps lower greenhouse gas emissions and mitigates the impact of climate change. Reducing Water Pollution: Water conservation can help prevent pollution by reducing the need for extensive water treatment processes. When water is used more efficiently, there is less runoff of pollutants from urban and agricultural areas into rivers and lakes. Economic Benefits: Water is a finite resource, and its scarcity can lead to economic challenges. Industries, agriculture, and businesses depend on water for their operations. Water shortages can disrupt supply chains, increase costs, and affect economic stability. Conservation practices help ensure a reliable and cost-effective water supply. Preserving Aquifers: Over-extraction of groundwater from aquifers can lead to land subsidence and the depletion of this vital resource. Water conservation measures, such as using water-efficient technologies and sustainable groundwater management, contribute to aquifer preservation. Mitigate Drought Impact: Water conservation becomes especially crucial during periods of drought. Conserving water helps communities and ecosystems withstand the challenges posed by reduced precipitation and ensures that water resources are available for essential needs. Community Resilience: Water conservation contributes to the resilience of communities in the face of water-related challenges. It helps ensure that there is enough water for essential activities, such as drinking, sanitation, and agriculture, even in times of scarcity. Regulatory Compliance: In many regions, there are regulations and restrictions on water usage. By practicing water conservation, individuals, businesses, and municipalities can comply with these regulations and avoid penalties. Regardless of	*(See above.)*

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324 *(cont.)*	1 *(cont.)*	SOCIO – Socioeconomics *(cont.)*	the alternative chosen by the Bureau or how the federal government proceeds with managing the Colorado River system, real estate markets and consumers must be a critical factor in these discussions. As climate change destabilizes the Colorado River system, federal, state, local and private investments in solutions will be critical. But these resources - including initiatives in the Infrastructure Investment and Jobs Act (IIJA) and the Inflation Reduction Act (IRA) - can only be deployed effectively if the Bureau is transparent in describing the changes on the river and on the places, people, and real estate markets that depend on it. Realtors believe that there are many approaches that property owners, communities and the private sector can take to enhance the viability and sustainability of current water resources and these principles must be considered during the negotiations.	*(See above.)*
370	1	SOCIO - Socioeconomics	The Bureau of Reclamation, is formulating plans to address the water supply shortage of the Colorado River, which used to supply 100% of the water that ended up in the Salton Sea. The Salton Sea had been part of the Colorado River watershed for over five million years. It is one of the places where the river would flow as it flooded and ebbed over those many years. This natural connection to the Colorado River was severed when the government decided to build the Hoover Dam to prevent the flooding of the river in order to protect the agricultural industries developing in California. Agricultural runoff then became the primary source of water for the Salton Sea. For more than 100 years, federal management of the Colorado River has chronically ignored the Salton Sea.	Thank you for your comment. Analysis for the Salton Sea as it pertains to the proposed action and alternatives is addressed. As noted in section 3.5.2, additional details are addressed in the US Army Corps of Engineers Environmental Assessment for the implementation of the 10-Year Plan projects for the Salton Sea (US Army Corps of Engineers 2022).

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410	8	SOCIO - Socioeconomics	The Revised DSEIS fails to address this possibility not only in delineating the scope of ITAs, but also in its analysis of the environmental consequences of agricultural impacts in Section 3.16.2, which assumes, incorrectly, that CAP reductions will lead to fallowing, rather than increased reliance on groundwater. The Revised DSEIS "applies the 2007 agricultural modeling framework," which similarly examined the impact of various allocation alternatives on agriculture in Arizona, stating that "[k]ey to this impact analysis is the assumption that the most conservative way to estimate impacts is to assume that, if a shortage occurs, farmers would react by fallowing irrigated lands." 39 While Reclamation acknowledged that "there are other sources of water that may be used by farmers in order to offset shortages" such as "by pumping additional groundwater" it nevertheless concluded that, because it was "difficult to project exactly how individual farmers, irrigation districts, or each of the Lower Division states may mitigate potential, future agricultural impacts from shortages," it would choose instead to assume "that other sources of water would not be available."40 The Revised DSEIS repeats the mistakes from the 2007 FEIS, again basing its fallowing assumption on the notion that because it will be "difficult to project" how farmers would respond to shortages, farmers would fallow their crops instead of using alternative sources of water. These assumptions run counter to the overdrafts that federal officials previously acknowledged before Congress, and to the current reality on the ground, which augurs toward a return to this untenable history. They also appear to contradict other sections of the Revised DSEIS. For example, in discussing the environmental justice impacts of Alternative 2 in Section 3.17.2, the Revised DSEIS concludes that "water users within [Pima and Pinal Counties] who would have water delivery reduced to zero would face disproportionate consumptive use impacts on irrigation. Farmers who have used CAP excess water to irrigate crops would need to use alternative water supplies, such as groundwater, if available, to continue agricultural production."42 Such an "internally inconsistent" decision is potentially arbitrary and capricious.43	Reclamation acknowledges the diversity of impacts that may arise during shortage conditions, some of which are difficult to predict or unquantifiable. Section 3.16.1 of the DSEIS, including pages 3-281 through 3-284, describes agricultural baseline conditions. The available baseline data does not support a conclusion that surface water reductions automatically correlate to equivalent increased groundwater use. The available data contains instances where groundwater use appeared to increase independently of surface water availability, for potentially many reasons outside of any federal actions or control. The agricultural model only includes analysis of direct reductions in water availability. Though secondary impacts may occur, it is not possible to quantify these impacts due to the high level of uncertainty. Accordingly, the section 3.16.2 impacts analysis of the alternatives acknowledges that it is difficult to project exactly how individual farmers, irrigation districts, or each Lower Division State may mitigate potential future agricultural impacts from shortages. However, for the purposes of fully analyzing potential impacts to agriculture, attributing Basin-wide net losses of surface water supply to agricultural production and fallowing enables Reclamation to quantify and monetize the full range of potential impacts for the purpose of comparing impacts across alternatives. Additionally, as for hydrologic impacts to groundwater resources, the available baseline data indicate that groundwater use may increase regardless of surface water availability, and groundwater use may vary based on many factors, including state or local regulations.
548	14	SOCIO - Socioeconomics	SUMMARY (3-261): Please remove subjective conclusory comments describing impacts to revenues. In fact, an impact of over $8 Million translates to over a 1 mill impact in the CRSP rate. In addition, revenues are not the only indicator of impacts. That indicator does reflect impacts to the Upper Colorado River Basin Fund and the expenses it is obligated to cover. However, the Summary section should comprehensively cover the impacts analyzed, not just revenues, and should include the referenced rate analysis.	Removed per comment.

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555	10	SOCIO - Socioeconomics	Additionally, the socioeconomic impact should highlight the cost of replacement power for lost generation due to persistent drought conditions. The Draft SEIS failed to analyze aspects of the Western Grid, including replacement power availability and scarcity pricing impacts in a capacity deficient market. The final report should include a wholistic representation of the impacts to hydropower at all the dams, not just Glen Canyon, and a more thorough analysis that includes the cost of replacement power should be performed. The report also highlighted the cost borne by federal hydropower preference customers. This accounts for over 10% of the budget at Hoover Dam, and a higher percentage at Glen Canyon Dam. It was mentioned in the Post-2026 scoping report to use federal hydropower as a revenue source for unfunded mandates. The proposed funding mechanism places the cost burden on Federal hydropower customers and this is not a sustainable funding proposal. Therefore, it is requested that the Bureau not obligate the hydropower customers with additional costs in the Near-Term SEIS process or Post-2026 process.	Impacts to the Western Grid that may be affected by Lake Mead or Lake Powell operations are outside the scope of this SEIS. The Proposed Action would continue to outperform the No Action Alternative under the driest conditions, particularly in 2026 when the No Action Alternative has the potential for dropping below minimum power pool and the Proposed Action would greatly outperforms the No Action Alternative. This will provide more certainty and reliability in providing hydropower deliveries to Colorado River hydropower customers.
557	17	SOCIO - Socioeconomics	In part 3.16 "Socioeconomics," the Revised Draft SEIS fails to discuss various reasonably foreseeable and significant socioeconomic impacts in California's Imperial and Riverside Counties related to the Proposed Action's negative effects on the Salton Sea. Those impacts should have been evaluated. [See comment letter for additional details regarding socioeconomic impacts for California's Imperial and Riverside Counties]	Analysis for the Salton Sea as it pertains to the proposed action and alternatives is addressed in cumulative impacts. The proposed action is anticipated to result in expedited, but not additional, impacts to lakebed exposure and resultant impacts to surrounding communities. Additional details are included in other resources sections, for example, 3.92, Air quality. As noted in section 3.5.2, additional details are addressed in the US Army Corps of Engineers Environmental Assessment for the implementation of the 10-Year Plan projects for the Salton Sea (US Army Corps of Engineers 2022).

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557	18	SOCIO - Socioeconomics	In my comments on the original Draft SEIS for near-term Colorado River operations I discussed in detail the environmental injustice problems at the Salton Sea that may be worsened by any action alternative that substantially reduces water deliveries to Salton Trough water rights holders, and I discussed pertinent legal mandates and directives related to environmental justice with which the text of the original Draft SEIS was required to comply but did not. As noted at the outset of my current comments, my earlier comments on the original Draft SEIS are fully incorporated herein by reference. The Revised Draft SEIS acknowledges Reclamation is required to incorporate environmental justice as part of its mission. Specifically, Reclamation admits it is necessary for the Revised Draft SEIS to "address, as appropriate, any disproportionately high and adverse human health or environmental effects of their actions, programs, or policies on minority and low-income populations." Nonetheless, unfortunately the Revised Draft SEIS does not present an appropriate or sufficient analysis of these issues concerning the Salton Sea region. First, for purposes of analyzing environmental justice issues, the Revised Draft SEIS inappropriately limits the "Tribal populations with potential to be affected by project management" to "those with current entitlements to receive Colorado River water in the Lower Basin." This limitation improperly excludes Tribes in the Salton Trough-including but not limited to the Torres Martinez Desert Cahuilla Indians, whose reservation adjoins the Salton Sea and its increasingly exposed lakebed-from the analysis of environmental justice issues. That exclusion is inappropriate in light of the fact that Salton Trough Tribes, and especially the Torres Martinez Desert Cahuilla Indians, will suffer foreseeable, significant, and disproportionate negative effects as a result of the Proposed Action's impacts on the Salton Sea, the lake's ecosystem and wildlife, and the environment. Second, the Revised Draft SEIS presents an inadequate analysis of potential human health impacts on environmental justice communities resulting from the effects of the Proposed Action on the Salton Sea. [See comment letter for additional details]	Actions considered in this SEIS are not the main drivers of change in Salton Sea exposed lakebed. There are many sources of dust emissions in the Imperial Valley, and Reclamation acknowledges that the Salton Sea is one of them. This SEIS is analyzing a short timeframe of the remainder of the interim period, through 2026. Further, the total amount of lakebed exposure does not vary between the No Action Alternative and the action alternatives in this EIS. The SEIS alternatives and the No Action alternative would result in the same level of lakebed exposure; the alternatives only vary in the rate of exposure. Section 3.9.2 acknowledges that dust is a concern for the Salton Sea area and that additional dust resulting from decreased water levels would affect local air quality and public health. Exposed lakebed at Salton Sea contributes a small percentage of dust in the area and there are several sources of dust in the area. Ongoing studies are assessing whether there is any additional hazard posed by Salton Sea lakebed dust compared with other dust sources in the area. For instance, the Natural Resources Conservation Service is currently surveying soil content for other drying lakeshores, such as the Salton Sea, to formulate a dust risk index and to provide insight into potential airborne toxins and effects on human health. Topics mentioned by the commenter are being analyzed in separate NEPA efforts such as the USACE Salton Sea Management Program Phase I: 10-Year Plan EA and the IID 2024-2026 Temporary Colorado River System Water Conservation Project. For instance, the IID 2024-2026 Temporary Colorado River System Water Conservation Project EA will have resource analysis section on Air Quality, Environmental Justice, and Human Health.
Form Letter 1	3	SOCIO - Socioeconomics	BOR should always consider economic values of recreation in any decisions regarding Lake Powell and Lake Mead. Glen Canyon National Recreation Area is a significant national treasure as well as a spectacular generator of economic growth. GCNRA averages $250 million to $450 million in annual revenue. It gives rise to over 5000 jobs. Its economic multiplier is 10, giving rise to somewhere between $2 - $4 billion in direct economic value to its surrounding and regional areas. The latest economic impact report from the National Park Service shows that Glen Canyon lost $207 million in economic activity during low water years of 2022 and 2023. Lake Mead lost $114 million to low water levels. These are not inconsequential losses, and they suggest that outdoor recreation on these reservoirs is one of the other important interests that needs to be a stakeholder in this process.	Thank you for your comment- the SEIS includes baseline data on the importance of water based on recreation for the regional economy (see for example, Table 3-92, with the total economic contributions from recreation occurring in the GCNRA, LMNRA, and GCNP). In addition, the economic analysis acknowledges the potential for economic impacts to the recreation sector and regional economy as a result of reservoir level changes. Insufficient information is available on specific changes to recreation visitation levels to provide input data for quantitative recreation contribution analysis by alternative.

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109	1	SUPPORT - Support project	The Fort McDowell Yavapai Nation (Nation) sees great value in the efforts made by the Bureau of Reclamation (BOR) to provide Colorado River information to tribal entities through the Tribal Information Exchange and appreciates this opportunity to provide general comment related to the subject Draft Supplemental EIS (Draft SEIS). The Nation is supportive of BOR efforts to maintain healthy reservoir levels and is currently participating in Lower Colorado system conservation under the Lower Colorado Conservation and Efficiency Program.	Thank you for your comment.
117	1	SUPPORT - Support project	NPS supports this timely process - NPS managers strongly support this SEIS process and the Post 2026 planning process to better balance inflow and outflows of Colorado River reservoirs and improve reservoir level stabilization. It is critical to act quickly to protect water supply, power production, water quality, socioeconomic benefits from recreation, and maintain river dynamics and variability for native riverine resources in the National Park units along the Colorado river. The Colorado River water supply serves over 40 million people and is critical to the protection of NPS managed resources. For NPS units along the Colorado River, the river is critical for at least one life phase of approximately 80% of the wildlife species found in this arid western landscape (Chaney et al 1990, Debano and Schmidt 2004, Hubbard 1977). It is important to stabilize supply and demand in this system to avoid a collapse of the system.	Thank you for your comment.
117	2	SUPPORT - Support project	NPS supports the movement toward proactive conservation to rebuild storage in the proposed action alternative - This proposed alternative in the SEIS is ground-breaking and a positive base on which to build long-term solutions in the Post 2026 process. It is encouraging to see the states come together and begin the process of building a proactive approach to conserve water rather than continue with a reactive approach. The volumes of water conserved to rebuild storage remain too low to avert the risks of system collapse, and additional work in the Post-2026 process will be needed. In the context of low storage elevations in lakes Powell and Mead, just two extreme low inflow years in a row could pose a major risk of the reservoirs dropping below powerpool and toward deadpool. Climate change is lowering the average inflows and increasing variability of inflows, which will mean "lower lows" could happen within this decade that are outside of what we have experienced historically. The situation we are facing is a climate trend (aridification) rather than a temporary drought; it is projected to continue and is expected to result in increases in temperature, evaporation, and soil drying, and to create even greater variability in the system while also lowering the average water availability (Bedri and Piechota 2022, Salehabadi et al 2022, Pokharel et al 2022, McCoy et al 2022, Whitney et al 2022). The NPS asserts that proactive conservation to rebuild reservoir levels will be the only way to reduce the risk of system collapse and to balance supply and demand at sustainable reservoir levels for the long term.	Thank you for your comment. This SEIS addresses actions in the remainder of the interim period, through 2026. Longer-term planning is being addressed through the Post-2026 process.

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117	4	SUPPORT - Support project	PS supports the proposed action in combination with the simultaneous planning effort by Reclamation on the Long Term Experimental and Management Plan (LTEMP) SEIS to protect federally listed fish populations. The proactive conservation of 3.0 million acre feet (maf) over 3 years and allowing for lower releases out of GCD (6.0 maf) may allow for better balancing of inflows and outflows to maintain Lake Powell levels. Maintaining Lake Powell and Lake Mead levels higher through proactive conservation is likely to help protect both the federally threatened humpback chub (HBC) in Grand Canyon and the federally endangered razorback sucker in the Grand Canyon and Lake Mead. Over 92% of the known adult HBC population exists in the Grand Canyon and though their reproduction appears to be showing increases currently correlated with the warmer river temperatures, the warmer water appears to be providing the habitat conditions for a rapid invasion by smallmouth bass, which was identified as the biggest potential threat to the species in a 2018 USFWS species status assessment. If smallmouth bass get established, they may dramatically decrease numbers of HBC larvae and young of year through predation. The sub-annual flows proposed under this related process to address smallmouth bass will be influenced by the annual flows analyzed in the SEIS. Annual volumes and the low elevation of Lake Powell have increased smallmouth bass and other warm water non-native passage through the dam, and increased river temperatures allowing breeding to occur downstream of the dam. These warmwater non- natives pose a major threat to the federally listed HBC and razorback sucker and the other native fish populations in the Grand Canyon, which have been thriving up until now in a stretch of river with low numbers of predators. Under the obligation of the Grand Canyon Protection Act (Public Law 102-575), this situation should be mitigated and NPS supports the Reclamation plan to initiate the LTEMP SEIS planning effort with a timeline of completion by May or June of 2023 to prevent establishment of these warmwater predators before they impact the native fish and federally listed species. Conservation of 3 maf over 3 years and adjustments to operations that can increase reservoir elevations and better balance inflows and outflows will help protect the endangered razorback sucker population in Lake Mead. Though this razorback sucker population is a small percentage of the total population of this species, as was stated in the 2018 USFWS species status assessment for razorback sucker, this is the only subpopulation of razorback sucker currently completing its lifecycle, without active management efforts. Conservation efforts that maintain Lake Mead levels and better balance inflow and outflow may help protect spawning habitat and water quality important to razorback sucker in Lake Mead.	Thank you for your comment.
138	1	SUPPORT - Support project	BRC supports Alternative 2, the Lower Division Proposal. This alternative is the only option that aligns with President Biden's Investing in America Agenda and supports the Colorado River Basin and its users. We applaud BOR for adopting this alternative as the proposed alternative. Conserving water is the common sense plan that benefits all users of the Colorado River.	Thank you for your comment.

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150	1	SUPPORT - Support project	I support Bureau of Reclammation adopting the lower basin states proposal as the preferred alternative for management of the Colorado River, in particular the higher trigger election of 3575 below which cutbacks will be triggered and lower releases from Glen Canyon Dam initiated. I fully support maintaining Lake Mead and Lake Powell at healthy levels.	Thank you for your comment.
284	10	SUPPORT - Support project	To that end, the Districts applaud the work of the Bureau and the Lower Basin States to develop the Proposed Alternative for operation of the River system. And, in large part, as discussed above, the Districts support the Bureau's adoption of that Alternative.	Thank you for your comment.
285	1	SUPPORT - Support project	We agree that "it is appropriate for the SEIS analysis to consider the No Action Alternative and the Proposed Action as a reasonable range of alternatives to reduce the risk of reaching critical elevations at Lake Powell and Lake Mead to acceptable levels in the pre-2026 SEIS timeframe."	Thank you for your comment.
294	1	SUPPORT - Support project	The FRWC continues to support the purpose and need for the proposed action and supports the assumption in the hydrology analysis that no potential Drought Response Operations Agreement (DROA) contributions be included in the modeled hydrologies for the no action alternatives, Alternatives 1 and 2, and the proposed action.	Thank you for your comment.
298	1	SUPPORT - Support project	SRP supports the Proposed Action alternative outlined in Section 2.7 of the Revised Draft SEIS and commends the efforts of the Lower Basin States and Reclamation to develop an alternative that protects critical elevations without imposing mandatory reductions that would have serious detrimental impacts. The Proposed Action alternative outlined in the Revised Draft SEIS incorporates the elements of the Lower Basin Plan submitted in May 2023. The modeling done by Reclamation using updated hydrology indicates that the voluntary conservation contemplated in that alternative, and largely effectuated through agreements that have already been finalized, is sufficient to avoid Lake Mead or Lake Powell dropping below critical elevations within the nearterm timeframe of 2026. The Proposed Action alternative avoids mandatory reductions beyond what has been agreed to in the 2007 Interim Guidelines and 2019 Drought Contingency Plan.	Thank you for your comment.
301	1	SUPPORT - Support project	The CRCNV supports Reclamation's efforts to modify near-term operations in preparation of potential continued low-runoff conditions due to climate change and drought until the post-2026 operational guidelines are implemented. The CRCNV appreciates Reclamation's decision to include the Lower Basin Proposal as the proposed alternative and eliminating Alternatives 1 and 2 from further analysis.	Comment noted.

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303	1	SUPPORT - Support project	The consensus commitments make the actions identified in the revised DSEIS more probable and provide the best opportunity at this time for increased stability in near-term water supplies while reducing the additional collective risk of time-consuming, expensive, and uncertain litigation that may otherwise occur. Fulfilling the purpose and need set forth in the revised DSEIS remains critical to navigating the Basin's current hydrologic and socio-political risks so the Colorado River community can turn its attention to planning for the long-term operation and management of the Colorado River system. We, therefore, support the revised DSEIS' proposed action alternative, and encourage Reclamation to adopt the proposed DSEIS action as the preferred alternative with the following understandings:	Thank you for your comment.
303	5	SUPPORT - Support project	The importance of near-term actions to help the Colorado River community direct attention to the long-term operation and management of the system incentivizes support for finalizing the DSEIS with the proposed action as soon as possible. Finalizing and implementing the DSEIS' proposed action is critical to the immediate stability of the system.	Thank you for your comment.
305	1	SUPPORT - Support project	Washington County is one of the fastest-growing communities in the nation. The county's population is project to more than double by 2050. Washington County is Utah's hottest, driest region. All major population centers are currently dependent on a single water source, the Virgin River Basin, which is reaching its full development capacity. Washington County has already reduced its per capita water use more than 30% since 2000 -- the greatest reduction in water use in Utah -- and is planning for an additional 24% reduction by 2070. The district's 20-year water supply plan includes additional conservation, regional reuse, local supply development, groundwater optimization, and agricultural conversion. Because the Virgin River is a tributary of the Colorado River located within the Colorado River Basin, Washington County's water supply is directly affected by Colorado River operations in both the near and long-term. The district hereby endorses and incorporates the Upper Colorado River Commission's comments on the Revised Draft SEIS.	Comment noted.
314	1	SUPPORT - Support project	The potential for reduced flows within the Grand Canyon under the Proposed Alternative do pose some concern from American Whitewater, however, the greater opportunity for variable river flows and higher potential for high flow experiments cannot be understated. These controlled and short high flows are incredibly important to transfer tributary sediment onto sandbars and beaches providing benefits to both recreation and riparian health. Therefore, American Whitewater is supportive of the proposed alternative that will allow for more flow variety in the interim while long term operations under a much broader scope can be considered.	Thank you for your comment.

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319	1	SUPPORT - Support project	It is because of this deep connection we feel to the River that we are so committed to engaging with the United States, our sister Tribes, the Basin States, and other stakeholders to find durable, sustainable solutions to the long-term hydrologic challenges facing the Basin. It is in this spirit that we were pleased to be able to work with contractors in the State of California on the development of the Lower Basin Plan that underpins the alternative identified as the proposed action described in Section 2.7 of the revised draft SEIS. We are proud to be able to dedicate over 20% of our total water rights in California to system conservation over the next three years in support of that Plan and we appreciate the leadership your agency has shown in entering into the System Conservation Implementation Agreement with the Tribe and the Metropolitan Water District of Southern California to facilitate our ability to make that contribution to protecting elevations at Lake Mead. We strongly support the adoption of the revised draft SEIS' proposed action alternative as the preferred alternative in your final SEIS. Adoption of that alternative will provide Reclamation with the tools it needs to manage the river system over the next three years while we collectively focus on the vital task of developing a longer-term Basin-wide management framework for the post-2026 period.	Thank you for your comment.

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324	3	SUPPORT - Support project	Water Storage and Infrastructure NAR urges states and localities to take advantage of the resources in the Inflation Reduction Act and the Infrastructure Investment and Jobs Act that provide programs to enhance water storage and infrastructure efforts. Investing in these activities is crucial for optimizing water resource management, enhancing resilience to climate variability, and supporting sustainable development. They provide a foundation for water security, economic growth and overall resilience for communities and ecosystems. Water Efficiency and Conservation Government entities and water management organizations play a pivotal role in developing and implementing policies that encourage water efficiency. Promoting the use of watersaving technologies and enforcing regulations on water usage can significantly contribute to reducing waste and increasing overall water conservation efforts. Additionally, financial incentives, such as tax rebates, credits or subsidies, can be provided to individuals and businesses that invest in water-efficient infrastructure and practices. Ecosystem Water Resources Another area of focus should be the restoration and protection of natural water resources, including rivers, lakes, and wetlands. These ecosystems not only provide habitats for diverse wildlife but also act as natural water reservoirs. By implementing conservation measures and adopting sustainable land management practices, the long-term viability of these ecosystems will be ensured and their invaluable contribution to water sustainability protected. Education and Awareness Education and awareness campaigns should be initiated at various levels of government to promote water-conscious behavior. By educating consumers about the importance of water conservation and providing practical tips on reducing water consumption, we can empower communities to make informed choices. This can include strategies such as fixing leaky faucets, installing water-efficient appliances, and adopting responsible landscaping practices. Collaboration and Partnerships Cooperation among governments, non-governmental organizations, businesses, and communities is vital to addressing the complex challenges of water efficiency and conservation. By fostering dialogue and sharing best practices, we can leverage collective wisdom and resources to develop innovative solutions that benefit everyone.	Comment noted.
340	2	SUPPORT - Support project	The SLRIW A appreciates that the Revised Draft SEIS eliminated Action Alternatives 1 and 2 from detailed analysis in the Revised Draft SEIS, and focused instead on the Lower Division Proposal, which is based on voluntary conservation measures, and is consistent with applicable federal laws, including the San Luis Rey Settlement Act.	Thank you for your comment.

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343	1	SUPPORT - Support project	Please support the Consenses-Based Modeling Alternative.	Thank you for your comment.
539	2	SUPPORT - Support project	Support of the Proposed Action (Lower Basin Proposal) - Voluntary, Compensated Reductions Mandatory, involuntary reductions in water use would be painful and devastating for most users and communities that rely on Colorado River water. The District and its growers and landowners are among those that would suffer significant impacts from uncompensated, mandatory cuts. The District supports the Proposed Action of the revised draft SEIS to the extent that it meets conservation requirements or needs through voluntary and/or compensated reductions.	Noted.
553	7	SUPPORT - Support project	Escondido and VID agree with and appreciate Reclamation's decision to designate the Lower Division Proposal as the Proposed Action and eliminate from its detailed examination Action Alternatives 1 and 2 from its prior draft SEIS. (Revised Draft SEIS, Appendix C.) As pointed out "based on the updated hydrology, the Proposed Action would provide additional risk reduction compared with Action Alternatives 1 and 2, while implementing similar flow reductions; therefore, Action Alternatives 1 and 2 were eliminated from detailed analysis in this revised Draft SEIS." (Revised Draft SEIS, Section 2.8.10.)	Noted.
556	2	SUPPORT - Support project	Proposed Action: Southern Ute supports the selection of the Proposed Action set forth in the Revised DSEIS. The Tribe is pleased to see the Lower Division States agree to conserve 3 million-acre feet ["maf"] of water through 2026,with a minimum of L.5 maf physically conserved by the end of the calendar year 2024. In addition, the Tribe supports the inclusion of the authorization for Reclamation to reduce water releases to 6 maf if Lake Powell is shown to drop below 3,500 feet in the 24-month Study's minimum probable scenario. This will be an extremely helpful tool if the hydrology does not improve. We appreciate the additional included protections for the critical elevations at both Lake Powell and Lake Mead and that there is no impact on the apportionments in the Upper and Lower Division States. The Tribe urges Reclamation to choose the Proposed Action, in order to take steps towards addressing this ongoing 23-year drought and ensuring there are additional tools to assist Reclamation in protecting the dams, public health and safety, and any other emergency situations, while working to develop the Post-2026 guidelines.	Thank you for your comment.
562	1	SUPPORT - Support project	The City of Tucson and Tucson Water recommend the implementation of the Proposed Action ("Lower Division Proposal"). The Proposed Action ("Lower Division Proposal") reduces the potential that continued low-runoff conditions could lead to Lake Powell and Lake Mead declining to critically low elevations. This protects critical infrastructure at both reservoirs and balances overall operational risks in the Colorado River Basin. The conservation efforts within the Lower Action Proposal are also consistent with the congressional direction to mitigate the impacts of long-term drought.	Thank you for your comment.
619	1	SUPPORT - Support project	The Hualapai Tribe supports this Proposed Action as a short-term solution, and believes it to be preferable to the No-Action Alternative. The Tribe submits these comments to address other elements in the process that Reclamation has initiated.	Thank you for your comment.

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636	1	SUPPORT - Support project	IID supports the Lower Division Proposal, the Proposed Action analyzed in the Revised DSEIS, which fulfills Reclamation's obligations under the National Environmental Policy Act and complies with the laws, court decisions and contracts that empower and constrain the Secretary of the United States Department of Interior and Reclamation with respect to the Colorado River.	Thank you for your comment.
Form Letter 1	1	SUPPORT - Support project	I support BOR adopting the lower basin states proposal as the preferred alternative.	Thank you for your comment.
297	45	UPPERDIVI - Water Deliveries to Upper Division States	A 2013 legal analysis by Larry McDonnel explored the concept, stating "There may be opportunities to put in place measures that would reduce the likelihood of a 75/10 shortfall such as using an accounting system to smooth out the annual variability of flows and even a relaxation of the requirement under certain circumstances65." Additionally, it's crucial that any operational analysis assess options for Upper Basin states to store water in Lake Mead in the form of an Intentionally Created Surplus (ICS). Similar ICS tools were essential in the 2007 Interim Guidelines and provided a framework and incentive for water users to conserve66.	This comment is outside the scope of this SEIS, which covers the remainder of the Interim Period, through 2026. Authorized conservation opportunities are currently available in the Upper Basin through the duration of the Interim Period and may be pursued by the appropriate parties. Additional flexibility for ICS may be considered as part of the Post-2026 process.
297	46	UPPERDIVI - Water Deliveries to Upper Division States	Some policy experts have recently argued that the Upper Basin's delivery obligation is unsustainable in a dwindling river system. If the delivery obligation is changed, the primary purpose of Glen Canyon Dam will change as well. As Eric Kuhn, former Director of the Colorado River Water Conservation District, said at the Getches Wilkinson Annual Summer Conference in 202367, "If the risk of a curtailment on the Upper Basin... is off the table, then the purpose of Lake Powell becomes very different". In an operational scenario where the Upper Basin is no longer required to release 75 million acre feet every ten years at Lee Ferry, the Upper Basin could then be allowed to count its delivery further downstream at Lake Mead. Even in amounts lower than 7.5 million acre feet, the omission of the delivery obligation would open up more flexibility to consolidate storage in one reservoir versus the other in an effort to minimize evaporative and seepage losses, and optimize environmental conditions in Glen Canyon and Grand Canyon.	This comment is outside the scope of this SEIS. Reconsideration of particular parties' obligations under interstate compacts is outside the scope of operations below Lake Powell for the remainder of the interim period, through 2026.
297	22	VEG - Vegetation and Noxious Weeds	A new and ongoing vegetation survey led by researcher Seth Arens of Western Water Assessment is looking at the vegetation composition in emerged areas in Glen Canyon, and has found that areas that have been out of water for more than 2-3 years are generally dominated by native plant species like willow and cottonwoods. As of summer 2023, the survey has established 89 transects in 20 locations throughout Glen Canyon. It should be noted that the findings of this vegetation survey are a stark contrast to the descriptions of emerging ecosystems in the DSEIS. The impact analysis of that EIS acknowledges on page 238 that the agencies lack any reliable data on new vegetation in Glen Canyon, stating, "vegetation monitoring does occur in the upland areas of the recreation area, but no studies have been conducted on the riparian habitat along the lakeshore."43 Then it contradictingly claims, "currently, tamarisk and Russian thistle are the dominant vegetation type along the shores of Lake Powell. Dense stands of tamarisk displace native plants, degrade wildlife habitat, reduce livestock forage, limit human access, interfere with the natural fluvial process, and increase the risk of severe wildfires."	The studies listed are ongoing and published results are not yet available. Available published data has been used in the analysis.

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297	23	VEG - Vegetation and Noxious Weeds	On Page 65, the DSEIS claims that the drops in reservoir levels in Glen Canyon are, "resulting in short-term changes to riparian vegetation, including an increase in invasive plant species and loss of suitable habitat for native plant species." This description of new vegetation and ecological succession in Glen Canyon is woefully inaccurate, and based on outdated, anecdotal, or non-existent data. In order for decision makers to accurately weigh the impacts of water operations on the ecosystems in Glen Canyon, a thorough study of its ecosystems must be incorporated into the decision making assessment and process.	We are using best available data at the time of the writing of the SEIS. If more up-to-date information is available, please provide it. This SEIS is for a short-duration while vegetation succession is change on a more long-term scale.
303	6	VEG - Vegetation and Noxious Weeds	The integrity of the Colorado River's remaining natural systems is foundational to ensuring the long-term viability of the River system for all who depend on it. The Colorado River's increasingly depleted and degraded ecosystems are more than another category of water user whose interests are to be balanced and weighed against competing priorities in the Basin	Thank you for your comment.
326	34	VEG - Vegetation and Noxious Weeds	[Section 3.13.1, page 3-168] Under "Hoover Dam to SIB," this paragraph would be much easier to understand if you just replaced it with a list of the cover types and subtypes.	The table from 2007 EIS has been inserted into the document for clarification.
326	35	VEG - Vegetation and Noxious Weeds	[Section 3.13.1, page 3-168] The section "Hoover Dam to SIB" mentions of tamarisk beetles. Were these intentionally released to control invasive tamarisk? I think the text is trying to say that the defoliation of tamarisk by the beetle is a positive thing, because it's helping to control a non-native species. But it never actually does say that outright - the reader has to assume. Please clarify.	Tamarisk beetle impacts are listed in the affected environment section. The tamarisk beetles can have both positive and negative impacts.
326	38	VEG - Vegetation and Noxious Weeds	[Section 3.13.2, line 22, 3-188] "Therefore, it is expected that the trends discussed above in Section 3.13.1 (i.e., encroachment of emergent wetland vegetation ...) would continue under this alternative." Section 3.13.1 (subsection "Lake Powell") doesn't actually say anything about encroachment of emergent wetland vegetation. Please resolve.	Revised text to better reflect the trends discussed in Section 3.11.1
326	39	VEG - Vegetation and Noxious Weeds	[Section 3.13.2, line 25, page 3-188] "Under the No Action Alternative, the NPS estimates that any additional acreage of exposed shoreline around Lake Powell has the potential to be invaded by invasive plant species such as tamarisk and Russian thistle." For how long? Is this expected to be permanent? Or would we only expect this to happen during low-water years? Would we expect these area to recover during a high-water year as invasive plants get flooded out?	This SEIS only addresses impacts through 2026. Future impacts of low water levels will be addressed in the post-2026 planning effort.
326	40	VEG - Vegetation and Noxious Weeds	[Section 3.13.2, line 13, page 3-189] "Total change in habitat (either from suitable to unsuitable or vice versa) is projected to be 19.6 percent of the riparian area in Marble Canyon, 18.6 percent of eastern Grand Canyon, and 22.8 percent of western Grand Canyon." Need to specify whether the change in the amount of suitable habitat is positive or negative. Also, explain what you mean by suitable habitat for native plant species. Can't native plant species potentially grow anywhere? Does this mean riparian habitat?	According the to the previous sentence, all changes are from suitable to non-suitable for the no action alternative. Text was updated in the SEIS to reflect that. Vegetation models were trained on extensive monitoring data and projected for individual species. Habitat suitability maps for each species were compared between the two scenarios to identify the amount of predicted habitat for each species that (1) switched from suitable to unsuitable, (2) switched from unsuitable to suitable, and (3) the original amount of suitable habitat. Native and nonnative species have different habitat suitability requirements, which were assessed using hydrological niche modeling per Palmquist et al. 2018 and Butterfield and Palmquist 2018.

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326	41	VEG - Vegetation and Noxious Weeds	[Section 3.13.2, line 16, page 3-189] "Nonnative plant species, as a group, are projected to gain suitable habitat..." Define what you mean by suitable habitat for nonnative plant species. Nonnative plants can survive in a wide variety of ecotypes.	Vegetation models were trained on extensive monitoring data and projected for individual species. Habitat suitability maps for each species were compared between the two scenarios to identify the amount of predicted habitat for each species that (1) switched from suitable to unsuitable, (2) switched from unsuitable to suitable, and (3) the original amount of suitable habitat. Native and nonnative species have different habitat suitability requirements, which were assessed using hydrological niche modeling per Palmquist et al. 2018 and Butterfield and Palmquist 2018.
326	42	VEG - Vegetation and Noxious Weeds	[Section 3.13.2, line 22, page 3-189] Consider changing the last two bullet points to a table showing the names of the plants, and whether each one increased or decreased, by reach. That would be more meaningful than knowing the number of plant species that increased or decreased.	A table has been added to the EIS to better display this information.
326	43	VEG - Vegetation and Noxious Weeds	[Section 3.13.2, line 11, page 3-190] "...at which point riparian habitat may be affected." Explain how riparian habitat would be affected, how much, and when.	"Affected" changed to "reduced". It's difficult to determine the spatial and temporal extent of these effects.
548	8	VEG - Vegetation and Noxious Weeds	3.13 BIOLOGICAL RESOURCES/3.13.2 VEGETATION (3-194): As noted above, given the current status of the LTEMP SEIS, the cumulative impact statement that "If one of the LTEMP SEIS flow options were implemented, it would not have a measurable effect on vegetation" is premature at best. The LTEMP SEIS alternatives have not yet been described or provided to the cooperating agencies or public for comment or analysis.	Added a reference to the LTEMP DSEIS and cited it.
555	4	VEG - Vegetation and Noxious Weeds	There is also some question as to the continued insistence of High Flow Experiments (HFEs) as the only option for building beaches. HFEs have been proven to increase beaches for a limited time (3-6 months), washing sediment downstream in the process. Erosion occurs from flow fluctuations, but the beaches return to their natural state after the sediment is deposited because river hydraulics haven't changed. For example, has there been any consideration to remove the invasive tamarisk to improve beaches for camping? We have long advocated for armoring of beaches to help in prevention of future erosion so HFEs wouldn't be necessary. Tamarisks were introduced to the Colorado River by the federal government during the 19th century. They have spread downstream (and continue to be transported by HFEs) and are choking out native vegetation and consuming precious water resources. Part of the Inflation Reduction Act (IRA) passed in June 2023, includes funds for eco-system restoration. Funding for removal should be pursued by the Bureau of Reclamation (Bureau) to restore riverine habitat. This could be achieved via mechanical removal, which could also serve the dual purpose of building beaches. Dredging is allowed downstream of Hoover Dam and should be considered downstream of Glen Canyon.	This issue is outside the scope of this SEIS. Removal of invasive vegetation is an NPS action covered as part of the LTEMP. Any proposed modifications to the high-flow protocol are being explored in the LTEMP SEIS.

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557	14	VEG - Vegetation and Noxious Weeds	Again, as explained earlier in these comments, it is improper for Reclamation to rely on a model-the revised SSAM that has been repeatedly altered by Tetra Tech during the past two decades for a variety of purposes-that is not publicly available, and does not appear to have been properly validated or peer- reviewed. Independent experts and other members of the public cannot evaluate the validity of the model, the soundness of the assumptions utilized for the modeling, the accuracy of the results, or the legitimacy of the conclusions drawn from them. This situation is untenable. In addition, the Revised Draft SEIS fails to acknowledge reasonably foreseeable and likely irreversible negative effects on native vegetation (which is much more diverse than the Revised Draft SEIS indicates) adjoining the Salton Sea shoreline, in associated wetlands, in riparian corridors along Salton Sea tributaries, in the vicinity of springs, and within irrigation drains. The Revised Draft SEIS also fails to discuss possible adverse impacts of the Proposed Action on groundwater levels in the Salton Basin, which help to sustain some vegetation and also support springs that native plants rely upon. It is reasonably foreseeable that changes to groundwater levels may occur as the Salton Sea recedes because of the Proposed Action, and those changes could negatively affect vegetation. Furthermore, it is misguided and inaccurate for the Revised Draft SEIS to imply that increases in exposed lakebed caused by the Proposed Action from 2024 through 2040 are not significant because the Salton Sea's water level would allegedly be stabilized from 2040 onward. Even if it is correct that the lake's water level will ultimately stabilize (which has not been demonstrated in the Revised Draft SEIS and in reality is highly unlikely to happen for a variety of reasons), harmful and likely irreversible consequences of changes to vegetation resulting from the Proposed Action will occur during the period prior to 2040. The alleged stabilization of the lake at a very low elevation after that period will not alter the harm that has already occurred.	The SSAM model represents the best available tool to evaluate inflow impacts to Salton Sea surface water elevation and uses widely accepted hydrological modeling practices. Although the California Natural Resource Agency (CNRA) does not post the SSAM model online, it is available to the public, scientific professionals, and partner agencies upon request. CNRA, US Army Corps, US Geologic Service, Reclamation and other partner agencies will evaluate the tool and update its parameters as necessary to support the ongoing Imperial Streams, Salton Sea, and Tributaries Feasibility Study. This SEIS analyzes impacts at the point of delivery, therefore, impacts to the Salton Sea have been described under cumulative effects. Topics mentioned by the commenter are being analyzed in separate NEPA efforts such as the USACE Salton Sea Management Program Phase I: 10-Year Plan EA and the IID 2024-2026 Temporary Colorado River System Water Conservation Project.
297	21	VISUAL - Visual Resources	The DSEIS's analysis of these geologic and visual resources is woefully inadequate for such a significant part of the Colorado Plateau. The SEIS only mentions two "attraction features" in its analysis: Cathedral in the Desert and the backs of Glen Canyon and Hoover Dams. Glen Canyon is home to hundreds if not thousands of visual/recreational attractions. Ignoring the impact of reservoir inundation on these attractions is a fatal flaw in the DSEIS.	Assessment of attraction features in the Draft SEIS is the same as was completed for the 2007 FEIS except Rainbow Bridge NM, which was removed from visual analysis as changing lake levels affecting recreation access would be the primary effect. The effect on access to Rainbow Bridge NM and other recreational attractions including those in Glen Canyon are contained in Section 3.14 - Recreation. Text was added to the visual resources section acknowledging that other attraction (geological) features previously inundated by Lake Powell could be exposed by lowering lake levels.

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557	11	VISUAL - Visual Resources	In part 3.10 "Visual Resources", the Revised Draft SEIS poses the question, "Issue 4: How would management of water availability for the Lower Division States affect the landscape character?" The text acknowledges that "potential changes to the shoreline of the Salton Sea, through adjustments in water management, would be visible from the Salton Sea State Recreation Area, Salton Sea National Wildlife Refuge, multiple California state routes (State Routes 78, 86, and 111), and adjacent residential areas."41 The Revised Draft SEIS admits, "Based on the expeditated [sic] exposure of the Salton Sea lake bed under the Proposed Action, resulting in the diminishing influence of water on adjacent landscapes, greater indirect impacts on the landscape character adjacent to the Salton Sea during the planning period are anticipated compared with under the No Action Alternative."42 However, the Revised Draft SEIS goes on to conclude without explanation "and does so based on modeling that is not publicly disclosed and does not appear to have been properly validated or peer- reviewed" that "The long-term impacts would become the same between the No Action Alternative and Proposed Action."43 It is impossible for independent experts or other members of the public to evaluate the soundness of the modeling or the accuracy of the conclusions drawn from it. It is unreasonable for the Revised Draft SEIS to rely on undisclosed and possibly invalid modeling to reach consequential conclusions about adverse impacts in the Salton Sea region attributable to the Proposed Action. [See comment letter for additional details regarding cumulative visual impacts]	The SSAM model represents the best available tool to evaluate inflow impacts to Salton Sea surface water elevation and uses widely accepted hydrological modeling practices. Although the California Natural Resource Agency (CNRA) does not post the SSAM model online, it is available to the public, scientific professionals, and partner agencies upon request. CNRA, US Army Corps, US Geologic Service, Reclamation and other partner agencies will evaluate the tool and update its parameters as necessary to support the ongoing Imperial Streams, Salton Sea, and Tributaries Feasibility Study. Text added to more directly state the difference between impacts during the planning period compared to long-term impacts through 2045 in the visual resources section.

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11	1	WATERCONS - Water Conservation / Drought	California's Imperial Valley uses about half the water from the Colorado River that is allocated to the Lower Basis States of the Colorado River of California, Arizona, and Nevada. President Joe Biden agreed to equal percentage water cuts to California, Arizona, and Nevada's allocations of Colorado River water. This was the SEIS recommendation option 3 by the Bureau of Reclamation; option 2 was what was agreed to with a consensus agreement by the Colorado River's Lower Basin States. It entailed how the Arizona farmers will save the most water by amount. The Department of the Interior has the Federal power and the previous thumbs up by the White House to reverse the Lower Basin State's agreement in favor of SEIS option 3. This would be to legally save from the Colorado River what the Bureau of Reclamation last Summer called a safe amount of water. This safe amount is between 2-4 million acre-feet per year to be saved in total water allocation by the Bureau of Reclamation each year from the Colorado River. The current Lower Basin State's deal saved 3 million acre-feet of water from the Colorado River over the course of the next three years. I suggest that all the water that is not spent for California's farmers of the Imperial Irrigation District to fallow their land be used for cloud seeding. This should be the case if the United States Federal government and/or the Department of the Interior do not force the California farmers into fallowing their land. The Upper Basin States seldom use all their water on irrigation. Nonetheless, they are receiving Federal money to fallow their land. Why not earmark the remaining excess to cloud seeding? $2.4 million has already been allocated by the United States Federal government for the Colorado River Basin States to cloud seed. Utah already has allocated over $10 million to cloud seeding in Utah. Why not have the Department of the Interior allocate all unspent funds from fighting drought to be used to cloud seed in all major parts of the Colorado River Basin that feed the Colorado River, a monetary amount in the billions? Cloud seeding is a proven science that once caused a flood in the Middle East during a drought and cloud seeding has been known to fill a stadium with snow. Cloud seeding is the best answer if the Federal government does not enforce Bureau of Reclamation SEIS option 3. The California State Assembly also has the power to make the California farmers of the Imperial Valley save an equal proportion of water as the Arizona farmers under the current deal. The next two years must see the creation of permanent agricultural water cuts in the Southwestern United States or at least overt funding of billions of dollars' worth of cloud seeding.	Cloudseeding is outside the scope of this SEIS.
49	1	WATERCONS - Water Conservation / Drought	1. The amount of water being used to “farm in the desert” needs to be reevaluated and reduced. 2. The amount of water lost due to evaporation from man-made lakes in Southern Nevada, is ridiculous. This may be “reclaimed water,” but the evaporated water is water that can’t be returned to the Colorado River for reuse and returned water credits. To me, it’s obvious it’s not a crisis being taken seriously until this huge waste is significantly curtailed. If we don’t get rid of these lakes all together, perhaps islands could be created to reduce the water surface and thus the amount of evaporation.	Evaporation and system losses are outside the scope of this SEIS. For more information on this issue, see the report published by Reclamation in early 2024. The report presents methodologies that have been used to develop those datasets; however, it does not make recommendations on how to implement or account for system losses from the lower Colorado River mainstream.

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295	7	WATERCONS - Water Conservation / Drought	The SEIS should include an analysis of the conservation benefits of water withdrawals conditioned upon the adoption of best practices for water efficiency that are already in use within the Colorado Basin states. Many important policies to promote water efficiency have been developed in the Basin states, but most are not universally applied. A non-exhaustive list that would provide short and long-term benefits include – * Require removal of non-functional turf grass. (Nevada) * Incentivize landscape conversion and turf removal statewide. (California, Utah) * Adopt stronger efficiency standards for plumbing and equipment. (Colorado, California, and Nevada) * Require urban utilities to report distribution system leakage, and to meet standards for reducing water losses. (California) * Require all new urban landscapes to be water-efficient. (California) * Require metering of landscape irrigation turnouts (Utah) * Ensure that existing buildings are water-efficient when they are sold or leased. (Los Angeles, San Diego) * Require agricultural water deliveries to be metered and priced at least in part by volume. (California) * Develop regulations for indirect (IPR) and direct potable reuse (DPR) of recycled water. (California and Colorado for DPR, additional states for IPR). Provide extensive funding for large scale water reuse projects that reduce Colorado River and other potable water demand.	Reclamation continues to work on these issues; however, they are not within scope of this SEIS. There are other funding opportunities through Bucket 2 here: https://www.usbr.gov/lc/LCBConservation.html and https://www.usbr.gov/watersmart/.

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310	1	WATERCONS - Water Conservation / Drought	Conservation and Stabilization Conservation needs to be the first and foremost means of action to protect Colorado River flows over the next two to three years. A temporary one-year surplus should be managed to replenish reservoirs in order to stabilize operations for the likely upcoming dry years driven by climate change. Some water agencies are already rolling back conservation measures, such as a ban on watering non-functional turf, because there is more water in the reservoirs now but there won't be in the future if existing conservation measures aren't maintained, and new ones introduced. Relying on historical river flows and long-past releases as a guide to the future is uninformed and highly risky. Because of low Powell/Mead volumes, one can only reasonably utilize river flow information from the last approximately one to three years for planning purposes in dam operation/diversions (rather than the ten-year moving average noted in RDSEIS, Figure 3-1). Yet, this is too short of a timescale to clearly confirm a steady climatic state (e.g., El Nino oscillations are on the order of ten years). It is therefore likely that the only guaranteed operating principle is to use what exists (accounting for evaporation, infiltration, diversion losses, etc.) of the last two or three years of river flow to inform current diversions.1 A recent (November 2, 2023) posting by Jack Schmidt (2023) emphasizes that after the abundant water years of 2011, 2017, and 2019 all of the water gains of those years were used up within two years. In assessing Basin-wide reservoir storage as of the end of October 2023, Schmidt reports that since the end of snowmelt (mid-July 2023) storage of water in Lakes Powell and Mead has declined by 400,000 af, but Basin-wide storage has declined by 1.6 million af, with nearly three-fourths of the decline occurring in reservoirs upstream of Lake Powell. Schmidt's calculations call into serious question whether by 2026 Basin-wide storage will be any higher than it was before the relatively abundant water year of 2023. He cautions "Let's continue to keep track of the rate of decline in reservoir storage, lest we quickly overspend our surplus." To prevent the surplus from quickly disappearing, he emphasizes that It is imperative for the Basin States, Tribes, and federal government to agree on ways to significantly reduce basin consumptive uses and losses lest we repeat the past and quickly consume the gains of WY [Water Year] 2023. Does the modeling done by Reclamation include the amount of water already lost from reservoirs upstream of Lake Powell, and how does Reclamation reconcile Schmidt's conclusions with the projected figures in the RDSEIS? We have also previously asked Reclamation to consult the work of the Utah State University Center for Colorado River Studies White Papers, in particular, Number 6 in the series (Wheeler, Kuhn, et al. 2021) for suggestions about alternative management scenarios, which think outside the box at a time when new river management approaches are needed. Reclamation should take a look at this body of work and hopefully utilize the models that have been developed by this research team.	Figure 3-1 is only used for informational purposes. We use annual values in the modeling. We are not relying on historical river flows. We are relying on a forecast based on past climate (1991-2020) and we reduced those forecasts to generate lower flows. The 30-year record is standard across NOAA. We model operations upstream of Lake Powell and initialize the model with May 2023 conditions. Evaporation and losses are included in the modeling upstream of Lake Powell. This SEIS is a supplement within the current operating framework through 2026.

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310	4	WATERCONS - Water Conservation / Drought	Fallowing is a prime tool to reduce demand permanently or temporarily, and the full societal impacts of fallowing on vulnerable communities must be recognized. Fallowing need not take agricultural land out of production permanently but can be practiced on a seasonal basis, as the Quechan (Kwatsáan) do, or for one year out of a three-year rotation, as the Palo Verde Irrigation District and the Metropolitan Water District of Southern California are doing.	No change. This SEIS is analyzing impacts at the point of delivery. Not all system conservation agreements will result in fallowing. Reclamation is not imposing fallowing measures on any water district. Water Districts are voluntarily entering into these agreements, and Reclamation does not know how exactly entities will engage in conservation measures. Analysis of specific types of measures would be too speculative. Individual conservation agreements, when they have more detail, will be subject to separate NEPA analysis. Districts are engaging in their own activities to mitigate socioeconomic impacts, which are reduced in comparison to mandatory shortages as a result of compensation paid to water users by the United States.
350	1	WATERCONS - Water Conservation / Drought	First, it is recommended not to implement Demand Side Management due to ethical concerns regarding limiting people's access to water. Secondly, if cities choose to forego water, it is important for them to be transparent and avoid making false assurances to residents. In the case of Phoenix, Vice Mayor Ansari previously stated that the decision would not have a negative impact on residents, but later the City Council decided to reduce water allocation and significantly raise water rates. Elected officials should prioritize honesty and open communication with the city's water users. Thirdly, the Arizona board members should collaborate with state legislators to develop a plan for utilizing the state's brackish water supply.	Demand side management is outside the scope of this SEIS.
550	4	WATERCONS - Water Conservation / Drought	1. The SEIS states that "intensive efforts are underway to facilitate water conservation actions in the Basin under a number of programs." However, the degree to which water conservation will ameliorate problems based on yet-to-be determined actions is unknown unless the Bureau enters into agreements with entities engaged in water conservation efforts.	Reclamation enters into individual system conservation agreements with water users. These actions are known and reasonably foreseeable, and therefore included in the Proposed Action.
283	7	WATERQUAL - Water Quality	Legal responsibilities through the Endangered Species Act (ESA) are also paramount. An increase in smallmouth bass and other predatory nonnative fish passing through Glen Canyon Dam, along with warmer water temperatures sufficient for these species to reproduce are a clear and present danger to the federally listed humpback chub. The establishment of these warm water non-native fish invaders could permanently shift Grand Canyon's aquatic ecosystem away from the fish assemblage typical of the last 50 years. (Schmidt, Yackulic and Kuhn, 2023). Due consideration must be made to keeping Lake Powell above the 3525' threshold to minimize pass-through and reduce warming of the river below Glen Canyon Dam. Please note that warmer water temperatures can also threaten the viability of the recreational rainbow trout fishery in the Glen Canyon reach.	Impacts of this action on humpback chub are analyzed in this SEIS and consultation with the USFWS on ESA compliance is ongoing.
285	11	WATERQUAL - Water Quality	Table 3-20 lists the salinity criteria for the Colorado River at the three salinity criteria stations ("below Hoover Dam," "below Parker Dam," and "at Imperial Dam"), but Section 3.8.2 only describes the environmental consequences of the proposed action and no action alternatives for the first salinity criteria station (and for Lake Powell). Presumably, the lower releases from Lake Mead analyzed under the proposed action would increase salinity at downstream salinity criteria stations and at the international boundary due to roughly similar total loadings in diminished river volumes, but apparently this analysis was not conducted. Please analyze and report the salinity impacts of the proposed action at the downstream salinity criteria stations and at the International Boundary.	Reclamation is using the best available science for this SEIS. While there is some salinity modeling available for Imperial Dam, the timeline required to update the assumptions and run the model would exceed the timeline for this SEIS. However, under no alternatives in this analysis does the salinity criteria exceed the salinity criteria at Hoover Dam. Reclamation will continue to comply with and meet Minute 242. No change made to this SEIS.

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288	28	WATERQUAL - Water Quality	Reclamation fails to take a hard look at the resources in Marble and Grand Canyons that will be negatively impacted by inadequate conservation and demand reductions by lower basin states. Low reservoir elevations at Lake Powell will increase water temperatures below Glen Canyon Dam if water is being released through the penstocks. Reservoir elevations and where water is released (through the penstocks or the river outlet works) is "a key determinant" of release temperatures from Glen Canyon Dam.82 Reclamation's modeling of the selected alternatives indicates that at the lower end of the modeled traces, Lake Powell could fall below minimum power pool (elevation 3,490 feet) as soon as 2025 and those reservoir elevations may hover around that "protection level" for the remainder of the interim period.83 Figure 3-35 shows the number of days with average release temperatures over 16 degrees C under the selected alternatives. Given that smallmouth bass are already reproducing in Marble and Grand Canyons, these temperatures will further exacerbate the likelihood that the establishment will continue. Without higher reservoir elevations to facilitate lower temperatures and a mechanism to ensure additional smallmouth bass do not pass through the dam "which is the subject of the LTEMP SEIS" the years of conservation efforts to ensure the survival and recovery of native humpback chub in Grand Canyon may be lost.	This issue is addressed in the LTEMP SEIS. We encourage comment in the EIS process associated with LTEMP, which will address, among other things, cumulative effects of this SEIS on the LTEMP SEIS. The actions evaluated were proposed by BOR under the assumption that these actions would affect SMB population. Any action has an inherent level of uncertainty in its effects.
306	11	WATERQUAL - Water Quality	Pp. 3-115-122: While the probability of HFE frequency, magnitude, and duration would not differ much between the NA and PA, GCWC continually reminds Reclamation that springtime HFEs are vastly preferable to high flows in November, when natural flooding rarely or never occurred in the pre-dam Colorado River. Springtime HFEs are preferable not only because of the more natural timing, but also because by waiting until spring, decisions about the amount of water available for such important and controversial management actions can be far more intelligently considered. The many positive benefits of naturally timed high flows were abundantly apparent after the springtime HFE in 2023, including shoreline habitat and sandbar rejuvenation during the spring and summer, when such resources are most urgently needed.	The Fall and Spring accounting windows are consistent with the current LTEMP protocol. Changing the sediment accounting window to only spring is not within the scope of this project and does not address the purpose and need. Potential changes to the sediment accounting windows will be analyzed under the LTEMP SEIS. No change has been made to this SEIS.
306	12	WATERQUAL - Water Quality	Pp. 3-123-5: Nutrient, particularly ortho-phosphate, concentrations may be strongly influencing foodbase development downstream from Glen Canyon Dam, but much uncertainty exists as to whether and how, under warm water conditions, available P affects that foodbase. At present, the macrophyte assemblage downstream from Glen Canyon Dam is dominated by species that do not support a high diversity of aquatic macroinvertebrates, and the few species that abound in that aquatic vegetation are non-native invasive species of low food value to fish, and which may out-compete taxa that have value to the fisheries there. The SEIS should state that resolving such uncertainties remains a primary research challenge, one preferably clarified before the end of 2026.	The Preliminary Draft SEIS relies on best available information and discloses uncertainties related to concentration and dilution capacity. Discussion of macroinvertebrate diversity and food value to fish is out of the scope of this analysis. No change has been made to this SEIS.
306	13	WATERQUAL - Water Quality	P. 3-132: Reduced flows in Grand Canyon may influence wind distribution of river sediment, and therefore contribute to increased burial and natural protection of archeological sites along the river. This should be mentioned in the Air Quality section for the Glen Canyon to Hoover reach, even though it is described in more detail in the archeology section on P. 3-152.	Fugitive dust from increased shoreline exposure is discussed in the air quality section, however wind blown dust is only discussed in terms of archeological terms in the archeology section. The discussion in the archeology section is sufficient and no changes will be made to the air quality section.

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310	12	WATERQUAL - Water Quality	Water within the Colorado River Basin must not only be of adequate quantity but it must also be of an acceptable quality. In light of the recent Presidential and Environmental Protection Agency initiative (United States President 2023) on assessing and reducing PFAs in our nation's water supply, we believe that Reclamation must add PFAs to the list of water quality constituents of concern (RDSEIS, p. 3-157). Indeed, Reclamation needs to assess the impacts of all chemicals which may be harmful to humans, both organic and inorganic, because research is finding an increasing number of connections between chemical pollution of water and health problems.	Reclamation is not aware of any modeling information available on PFA levels that would provide information to differentiate PFA levels among the alternatives being considered. To the extent that PFAs considerations are present, local water providers are responsible for any treatment. No change was made to the SEIS.
326	48	WATERQUAL - Water Quality	[Section 3.13.2, page 3-197] This paragraph implies that colder water temperatures would only affect rainfow trout and smallmouth bass. Describe which other species would also be affected.	This paragraph has been updated to provide examples of other coldwater species that would be similarly affected.
326	50	WATERQUAL - Water Quality	[Section 3.13.2, page 3-198] Explain the effect of the No Action alternative on algal blooms, fish, and wildlife in and near Lake Mead.	The SEIS has been updated to more clearly differentiate between the No Action and Proposed Action with regard to algae and invertebrates.
370	3	WATERQUAL - Water Quality	This Bureau of Reclamation document goes through the possible ways that their Proposed Action for 2024-2026 might harm the Salton Sea. It says that any harm done to the salinity, temperature, sedimentation, dissolved oxygen, nutrients and algae, metals and other contaminants, or air quality don't matter. It repeats over and over again that any possible harm will be offset by the improvements to all these conditions made by the 10 Year Plan! There is no basis for this statement. As stated above, so far there have been no improvements made by the 10 Year Plan, and conditions continue to worsen. The Bureau of Reclamation is relying on the bad advice, and invalid assumptions of California Natural Resources Agency and the Salton Sea Authority.	Reclamation is using best available information for this analysis. This SEIS states that the proposed action could expedite impacts to the Salton Sea, but not cause additional impacts when compared to the No Action Alternative.
484	15	WATERQUAL - Water Quality	Salinity "Implementing measures on private agricultural lands results in salinity controls." (pg3-85). This is a bit of a misleading statement. The largest single salinity control project (Paradox Valley Injection Well) is on federal land and many other salinity control efforts also occur on federal lands.	The SEIS was updated to acknowledge more explicitly that salinity control efforts also occur on federal lands.
484	16	WATERQUAL - Water Quality	Temperature Does Figure 3-28 (pg 3-102) Exceedance Probability for Temperature and Salinity Concentrations in Glen Canyon Dam Releases take into account that the temperature prediction model for Glen Canyon Dam releases is known to forecast temperatures that are up to 3 degrees C lower than observed release temperatures during critical times of the year (smallmouth bass spawning period)? The failure of the model to accurately predict water temperatures of Glen Canyon Dam releases during critical periods is well-known and should be addressed in this SEIS. Keeping Lake Powell storage higher would help provide cooler water for releases.	The model used represents the best available information. Reclamation is aware of the discrepancy in 2023 and is actively seeking to improve the model's accuracy. The issues referred to in this comment were present in a previous version of the model that was used in support of the Original Draft SEIS, but the model's accuracy has since been improved with additional data. The updated outputs based on the improved model were used in the Revised Draft SEIS.

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557	7	WATERQUAL - Water Quality	In part 3.8 "Water Quality," section 3.8.2 "Environmental Consequences," the Revised Draft SEIS fails to present an adequate analysis of the impacts of the Proposed Action on important water quality parameters in the Salton Sea, associated wetlands, and tributaries- including agricultural drains and rivers carrying irrigation drainwater. The Revised Draft SEIS also fails to consider the negative impacts on wildlife and people that could foreseeably result from adverse effects on water quality. Moreover, the Revised Draft SEIS unjustifiably dismisses all water quality impacts as de minimis effects that do not qualify as "Cumulative Impacts" of concern, by repeatedly asserting inaccurately that proposed habitat revitalization and dust mitigation projects that have not even been fully planned, approved, and funded-let alone constructed and fully implemented to successful operational status-will "continue to improve conditions" at the deteriorating Salton Sea. These problems are discussed further in the sub-sections below. [See comment letter for additional details on water quality impacts to the Salton Sea related to Salinity, Temperature, Sedimentation, Dissolved Oxygen, Nutrients and Algae, and Metals and Other Contaminants]	This SEIS analyzes impacts at the point of delivery. A comprehensive analysis of effects at the Salton Sea is currently in progress through distinct National Environmental Policy Act (NEPA) processes. These processes include the U.S. Army Corps of Engineers - Salton Sea Management Program (SSMP) Phase 1: 10-Year Plan (2018-2028) and the IID 2024-2026 Temporary Colorado River System Water Conservation Project.
124	1	WILDAQUA - Aquatic Wildlife	Amphibian populations are declining worldwide, and amphibians are experiencing high extinction rates due to habitat loss, chytrid fungus, pollutants, pesticides, and climate change. Amphibians are the most threatened class of vertebrates and merit special attention in the SEIS for Near-term Colorado River Operations. The Colorado River is the most important waterway in the southwestern United States and is a key resource for amphibians. Thank you for giving attention to common amphibians (canyon tree frog, red-spotted toad, and Woodhouse's toad) in the Glen Canyon Dam to Lake Meade reach (SEIS page 3-170). In the SEIS, please provide protective measures for special status amphibian species including Couch's spadefoot, foothills yellow-legged frog, lowland burrowing treefrog, northern leopard frog, relict leopard frog, Sinoloan narrow-mouthed toad, Sonoran green toad, and western spadefoot (SEIS page 3-178). Protective measure should include delineation of potential habitat areas and amphibian population monitoring. The reach from Hoover Dam to the Southern International Boundary appears to be the most important part of the Lower Colorado River basin for amphibian protection since amphibian diversity appears to be higher in this area.	In order to provide consistency across the analysis area, BLM sensitive species were addressed in the document. The special status species mentioned were considered. Some were eliminated (see Appendix G) and others were retained for analysis. Based on our analysis there are no impacts to the sensitive amphibian species mentioned that require protective measures to address.
288	8	WILDAQUA - Aquatic Wildlife	This Revised Draft SEIS process is inextricably linked with the LTEMP SEIS and together the decisions made could determine the fate of the last stronghold of humpback chub in the basin.	Thank you for your comment. The LTEMP SEIS is being considered as a cumulative action for this EIS, and vice versa.
297	20	WILDAQUA - Aquatic Wildlife	Any decisions made about how much water to store in Glen Canyon could have a significant impact on endangered and threatened species in Glen Canyon's restoration zone. The lack of any such analysis of those biological resources is a fatal flaw of this Draft SEIS.	We addressed T&E species in the Glen Canyon/Lake Powell section and in the BA.
302	7	WILDAQUA - Aquatic Wildlife	It should be noted that non-native fish are captured by velocity currents near the intakes of the penstocks at elevations near and above 3,520 feet.	This is referenced on page 3-171, line 10-12. Additional information included in write-up

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306	8	WILDAQUA - Aquatic Wildlife	P. 3-50, and subsequent Cumulative Effects summaries: In the text Reclamation claims that neither the NA nor the PA will have impacts on the LTEMP SEIS control measures for smallmouth bass (SMB). The text states "...minimal cumulative effects would occur on reservoir releases due to proposed operational changes evaluated in the LTEMP SEIS." GCWC wishes to point out, however, that the effectiveness of SMB control is highly uncertain. If control efforts are unsuccessful, additional flow-related measures may be required within the period of concern in this SEIS. Acknowledgement of at least some uncertainty is warranted in these several Cumulative Impacts sections.	This issue is addressed in the LTEMP SEIS. We encourage comment in the EIS process associated with LTEMP, which will address, among other things, cumulative effects of this SEIS on the LTEMP SEIS. The actions evaluated were proposed by BOR under the assumption that these actions would affect SMB population. Any action has an inherent level of uncertainty in its effects.
306	19	WILDAQUA - Aquatic Wildlife	P. 3-170 (Glen Canyon Dam to Lake Mead): In addition to riparian and upland vertebrates inhabiting this reach, there are thousands of riparian and aquatic invertebrates, including several rare and endemic species, such as the Grand Canyon tiger beetle (Cicindelidia hemorragica arizonae), Tapeats robber fly (Efferia tapeats), masked clubskimmer dragonfly (Brechmorhoga pertinax), the formerly endangered Kanab ambersnail (incorrectly referred to - it is now Oxyloma haydeni haydeni), and other taxa (Stevens 2012). P. 3-171: "Quagga mussels are not considered an issue in this section due to the riverine habitat..." McDaniel et al. (2021) documented quagga mussel densities >3,000/m2 in the Glen Canyon Dam tailwaters, and many thousands/L of veligers were reported by the NPS passing through Glen Canyon Dam several years ago. Low flows are likely to mean prolonged periods of clear water through Grand Canyon, conditions that will facilitate at least sporadic quagga mussel invasion of the river corridor and perhaps via human transport, upstream into the perennial tributaries in Grand Canyon. Such an invasion will have innumerable impacts on the integrity of the last-remaining relatively pristine perennial streams in Grand Canyon and the American West. Similarly, non-native crayfish invasion increases as water temperature warms. Crayfish invasion of Grand Canyon will greatly alter all aspects of the aquatic ecosystem, as they are highly predatory and will decimate native invertebrate and fish populations. Consideration of the impacts generated by these predatory invertebrates under warmer water and lower flows should be included in the Grand Canyon section of this document.	The information provided has been included where indicated. We are unable to find the cited report and the commenter will be asked to provide the McDaniel et al. 2021 report. Additional information on quagga mussels has been included in other sections of this SEIS, based on other studies, such as Pucherelli et al. 2016.
306	23	WILDAQUA - Aquatic Wildlife	P. 3-199: The habitat modeling exercise shows relatively similar impacts of both alternatives on shoreline vegetation and wildlife between Glen Canyon Dam and Lake Mead. However, one of the most striking features of Glen and Grand Canyons is the absence of mosquitoes and most other biting flies (Stomoxys populations have been increasing in summertime in recent years). Warmer, lower, slow-moving water under both alternatives may present conditions that greatly facilitate eruption of mosquito, ceratopogonid, other biting fly, and pest trichopteran and ephemeropteran populations that alter ecosystem structure and reduce visitor satisfaction. Such pest eruptions of biting flies occur on the Green River and downstream from Hoover Dam with mayflies and caddisflies, making visitation and research there extremely challenging in some seasons. Such issues should likely be mentioned in this section.	Thank you for your comment. Visitation data demonstrating the correlation between pest eruptions and reduced visitation for the area downstream from Hoover Dam is not available. No change has been made to the recreation section.

Letter Number	Letter Comment Number	Comment Code	Comment Text	Response
306	24	WILDAQUA - Aquatic Wildlife	P. 3-200: The section about aquatic foodbase responses to HFE timing is brief, with no clear difference between alternatives. However, benthic anoxia (McDaniel et al. 2021), the contemporary and highly dynamic macrophyte assemblage, and the changing diatom assemblages in the Glen Canyon Reach are not mentioned in this section. Also, add the word "a springtime" before "HFE" in the following phrase: "...the Colorado River system, the likelihood of HFEs is lower."	This issue is addressed in the LTEMP SEIS. We encourage comment in the EIS process associated with LTEMP, which will address, among other things, impacts on the aquatic food base in response to HFE timing.
326	23	WILDAQUA - Aquatic Wildlife	[Section 3.13.1, 5th paragraph, 6th sentence, page 3-171] Sentence reads, "Lake Mead also supports the largest self sustaining population of razorback suckers in the Colorado River system, with most of the fish found in the Colorado River and Virgin River inflows." Please replace "largest" with "only."	Replaced "largest" with "only"
326	24	WILDAQUA - Aquatic Wildlife	[section 3.13.1 page 3-171] "Quagga mussels are not considered an issue in this section due to the riverine habitat." This sentence is unclear. Do you mean: quagga mussels are not likely to be present in this section due to lack of suitable habitat?	The information provided has been included where indicated. We are unable to find the cited report and the commenter will be asked to provide the McDaniel et al. 2021 report. Additional information on quagga mussels has been included in other sections of this SEIS, based on other studies, such as Pucherelli et al. 2016.
326	29	WILDAQUA - Aquatic Wildlife	[Section 3.13.1, page 3-185] It's not clear whether or not woundfin are present in the affected area. Start with a sentence that says something like: Woundfish are (or are not) present in the affected area.	Reworded to state that they are not in the affected area and outside the area of analysis.
326	32	WILDAQUA - Aquatic Wildlife	[Section 3.13.1, page 3-201 to 302] Former comment: "Consider including information about warmer temperature possibly increasing chance of increased movement and changes to the existing warm-water nonnative fish assemblage in this large river reach." To provide additional context to this previous comment; we are particularly concerned about the range expansion of flathead catfish. Please provide additional status and justification for how there will be no changes to flathead catfish status.	Updated FSEIS to include further discussion of flathead catfish.
326	33	WILDAQUA - Aquatic Wildlife	[Section 3.13.1, page 3-165 to 3-168] This section includes a discussion of terrestrial vegetation, which is an important land cover type that provides habitat for terrestrial species. However, a section specifically focusing on aquatic habitats for fish is lacking. This section would benefit from the addition of an aquatic section. For example; on page 3-168, there is an overview of decreasing lake parameters leading to an increase in terrestrial vegetation shoreline increase, but this could also lead to a decrease in aquatic shoreline shrinkages (which is fish habitat).	Updated the document to include more information about aquatic shoreline habitat.
326	36	WILDAQUA - Aquatic Wildlife	[Section 3.13.2, page 3-186] "The analysis area for fish and aquatic species includes the Colorado River and associated aquatic habitat that is contiguous with the mainstream Colorado River..." It's not clear whether the analysis area includes tributaries to the Colorado River, and if so, how far upstream.	The analysis area only includes the mainstem of the Colorado River and associated contiguous habitat such as backwaters and marshes. It does not include tributaries.
326	47	WILDAQUA - Aquatic Wildlife	[Section 3.13.2, page 3-197] The paragraph beginning "sandbars that form..." does not explain the effect of the No Action on backwaters, humpback chub, or flannelmouth suckers. Please add that information.	This section is under the No Action. GCD operations under the No Action may impact backwater habitats; however, the use of backwater habitat is likely not a required habitat type for native fish habitat persistence. We revised the wording of this paragraph to make the connection between the desiccation of the backwaters and the impact to the fish species more clear

Letter Number	Letter Comment Number	Comment Code	Comment Text	Response
326	53	WILDAQUA - Aquatic Wildlife	[Section 3.13.2, page 3-200] Paragraph beginning "Impacts on the invertebrate and algal communities..." does not explain how the effects of the Proposed Action on invertebrates and algae differ from the effect of the No Action on invertebrates and algae. Please add this information.	The text has been revised to: "Impacts on the invertebrate and algal communities in the Lees Ferry reach are not expected to differ greatly between No Action and the Proposed Action. Higher dam releases under the Proposed Action are expected to maintain a greater wetted area in peripheral habitats that will maintain more robust invertebrate and algal communities. The impacts would differ depending on whether a fall (October–November) or spring (March–April) HFE was implemented. "
326	59	WILDAQUA - Aquatic Wildlife	[Section 3.13, page 3-219] The draft SEIS concludes effects to desert pupfish and Yuma Ridgway's rail from the proposed action would be similar to those of the No Action Alternative, specifically stating that there is no substantial difference in changes to water when comparing the two alternatives. However, desert pupfish and Yuma Ridgway's rail occur in the permanent wetlands downstream of agricultural drains that drain on the exposed lakebed surrounding the Salton Sea. The Proposed Action indicates that 840,000 acre-feet of additional water conservation between 2024 and 2026 would be undertaken by Imperial Irrigation District and Coachella Valley Water District (Table 3-3). This water conservation is in addition to commitments made under the Quantification Settlement Agreement, so declines in wetlands supported by agricultural drain runoff would be in addition to what would occur under the No Action Alternative. Please revise the statement that effects would be similar and acknowledge the increase in water conservation under the proposed action. Also, please include a discussion of the occurrence of Yuma Ridgway's rail and desert pupfish in the wetland areas downstream of the agricultural drains. The Service's biological opinion for the Salton Sea 10-Year Management Program, issued to the Army Corps on February 23, 2023, can provide baseline desert pupfish occurrences in these locations.	A change was made to the paragraph reflecting the comment and the USACOE 2023 Plan regarding desert pupfish and the rail. Reclamation also anticipates this analysis will be in the EA for the IID reductions.
484	18	WILDAQUA - Aquatic Wildlife	Assumptions " Vegetation, Wildlife, and Special Status Species" "The vegetation and wildlife and fish assumptions are the same as those described in the 2007 FEIS" (pg 3-187). Is this appropriate given what we now know about the presence and threat of warmwater invasive species below Glen Canyon Dam?	The assumptions remain appropriate. Modern invasive species, such as smallmouth bass, are being addressed through separate processes and analyzed in the SEIS as cumulative effects. No change was made to the document.
484	19	WILDAQUA - Aquatic Wildlife	Cumulative Effects Under most hydrologic traces, there was very little relative difference in smallmouth bass population growth between the No Action and Proposed Action scenarios (Eppehimer and Yackulic 2023)(pg3-203). Does this account for the inaccuracies of the temperature model which currently under-estimates temperatures by up to 3 degrees Celsius during portions of the year that are critical for smallmouth bass spawning and growth? Smallmouth bass entrainment rates are expected to be similar between the No Action and Proposed Action scenarios under most, but not all, hydrologic scenarios (pg 3-220). Does this account for the inaccuracies of the temperature model which currently under-estimates temperatures by up to 3 degrees Celsius during portions of the year that are critical for smallmouth bass spawning and growth?	The model used represents the best available information. Reclamation is aware of the discrepancy in 2023 and is actively seeking to improve the model's accuracy. The issues referred to in this comment were present in a previous version of the model that was used in support of the Original Draft SEIS, but the model's accuracy has since been improved with additional data. The updated outputs based on the improved model were used in the Revised Draft SEIS. In addition, the Proposed Action allows releases from Powell down to 6.0 maf, which will keep Powell elevations higher and help keep water temperatures lower compared to the No Action Alternative.

Letter Number	Letter Comment Number	Comment Code	Comment Text	Response
484	20	WILDAQUA - Aquatic Wildlife	Table 3-30 This should address the potential impacts on fishes (native and invasive) of algal blooms and dissolved oxygen changes due to increased temperatures and a decrease in the range of flow fluctuations.	Table 3-30 shows potential impacts to special status species between Glen Canyon Dam and the Colorado River inflow to Lake Mead. No algal blooms or dissolved oxygen changes are expected in this reach. However, as stated in the document, these conditions are experienced in Lake Mead and Lake Mohave. Tables 3-31 and 3-32 show impacts to Lake Mead and Lake Mohave, respectively, and bullet statements have been added to these tables on the possibility of impacts of algal blooms and low dissolved oxygen on the appropriate fish species.
555	7	WILDAQUA - Aquatic Wildlife	* Will HFEs transport Smallmouth Bass and other non-native predators downstream into the federally protected Humpback Chub habitat? o The Adaptive Management Work Group should study the migration downstream of non-native fish due to HFEs. We appreciate that HFEs will not be allowed if the elevation of Lake Powell goes below 3,500'.	This is being analyzed under LTEMP SEIS. We encourage comment in the EIS process associated with LTEMP, which will address, among other things, impacts on humpback chub.

Letter Number	Letter Comment Number	Comment Code	Comment Text	Response
557	15	WILDAQUA - Aquatic Wildlife	The Revised Draft SEIS then poses the question, "Issue 2: How would changing flow characteristics affect wildlife?"55 In response the text admits, "Water elevations are predicted to be lower under the Proposed Action for the Salton Sea, exacerbating existing issues of water availability and salinity for migratory birds and terrestrial wildlife."56 The Revised Draft SEIS also acknowledges that "[r]eductions in flow and increased salinity may reduce habitat for tilapia,"57 but does not then specifically state that decreased numbers of tilapia will have direct and significant negative impacts on the many species of piscivorous (fish-eating) birds reliant on the Salton Sea ecosystem, including special status species that are already in jeopardy. The Revised Draft SEIS does not address the negative effects on wildlife reliant on the Salton Sea ecosystem that could result from reduced flows in irrigation drains and rivers carrying Colorado River wastewater, and from decreased water in associated wetlands; instead the text unjustifiably assumes there will be no such negative effects. In reality, adverse impacts may be significant for some species, including special status species, and should have been evaluated. The failure to do so resulted in erroneous conclusions in the Revised Draft SEIS. For example, in Appendix G to the Revised Draft SEIS, which presents information concerning potential negative impacts on species of special conservation concern, the entry for the least bittern (Ixobrychus exilis) inaccurately states that particular species "is not found in habitat that would be impacted by any alternatives." But clearly the least bittern utilizes marshes in the Salton Sea ecosystem: "In the Salton Sea area, most bitterns reside in freshwater marshes in managed impoundments, along rivers or canals sustained by agricultural wastewater, and on lake edges; they are found particularly in dense stands of cattails but also in Common Reed (Phragmites australis) and even dense tamarisk (Tamarix spp.) if cattail is nearby (Patten et al. 2003)."58 Therefore, the mistaken assertion in Appendix G regarding a lack of negative effects on the least bittern appears to be based on the incorrect assumption that marshes in the Salton Sea region sustained by Colorado River wastewater-including, but not limited to, marshes at the receding edges of the Salton Sea- will be unaffected by the Proposed Action. Contrary to that assumption, it is reasonably foreseeable that the Proposed Action will, at a minimum, cause reduced flows in streams and wetlands sustained by agricultural wastewater; and therefore the habitat relied upon by least bitterns in the Salton Sea ecosystem could indeed be adversely affected, with associated negative consequences for the birds themselves. [See comment letter for additional details regarding wildlife impacts, including cumulative impacts]	This SEIS analyzes impacts at the point of delivery, therefore, impacts to the Salton Sea have been described under cumulative effects. Topics mentioned by the commenter are being analyzed in separate NEPA efforts such as the USACE Salton Sea Management Program Phase I: 10-Year Plan EA and the IID 2024-2026 Temporary Colorado River System Water Conservation Project.

Letter Number	Letter Comment Number	Comment Code	Comment Text	Response
297	24	WILDTERR - Terrestrial Wildlife	The DSEIS also erroneously claims the emerging vegetation is harming wildlife. This couldn't be further from the truth. Abundant wildlife has been documented in emerged canyons of Glen Canyon including bighorn sheep, mule deer, coyote, bobcat, beaver, river otter, numerous lizards and snakes44. Dozens of invertebrate species such as bees, beetles, and dragonflies have also been documented in the emerged areas45. These emerging landscapes provide native species the ability to compete with non-native species and to add to the ecological integrity of the Colorado River system. They may also be providing streamside habitat for threatened or endangered species such as the Willow Flycatcher or Yellow Billed Cuckoo. The western United States has lost thousands of acres of habitat for native species due to various forms of development and use. As such, it is of the utmost importance to recognize Glen Canyon's unique place in the landscape for both human and non-human species and they should have been considered in the analysis of the DSEIS.	The RDSEIS does not claim that vegetation in emerged canyons in the Lake Powell area would harm, or is harming, wildlife. The only discussions of this indicate that riparian vegetation may shift location as water levels change, changing the location of this kind of habitat.
306	20	WILDTERR - Terrestrial Wildlife	P. 3-174 Table 3-24: Because both Glen Canyon National Recreation Area (GLCA) and Grand Canyon National Park (GRCA) require that construction and conservation actions not take place during Mexican Spotted Owl breeding season, and because that species has been detected in the GRCA river corridor, it is advisable to add that species to this table. Similarly, GRCA includes land near Meadview, Arizona called "The Hook", which may support desert tortoise, that species could be included in this table.	Desert tortoises are included in table 3-24. Mexican spotted owls were not documented as present in the analysis area and were not included.
306	21	WILDTERR - Terrestrial Wildlife	P. 3-175 et subsequ. Table 3-25: This table is so fraught with error and is highly dis-informative. Species to add under the Lake Powell column include: peregrine falcon, Lucy's warbler, Phrynosoma hernandezi, and monarch butterfly. Species to add in the Glen Canyon Dam to Lake Mead reach include: white pelican, Bell's vireo, California brown pelican, least bittern, phainopepla, fringed myotis, Lasius cinereus, Townsend's big-eared bat, Gila monster, and relict leopard frog. The following species should be deleted from the Glen Canyon Dam to Lake Mead column include: lowland burrowing treefrog, Sinaloan narrow-mouthed toad, Sonoran green toad, Uma rufopunctata, Tryonia gilae, and Sonoran talussnail. The Apache springsnail exists only at uppermost elevations on the southern Colorado Plateau margin, and will not be affected by dam management operations or policies. The potentially sensitive plant species listed in this reach were not reviewed in detail, but several species do not exist there, including Erynginum sparganophyllum, Fish Creek fleabane, and Hohokam agave. We did not review the other columns in this Table. Data supporting our conclusions about regional biogeography are derived from GRCA (2023), Stevens (2012), and references cited therein. With so many basic errors, we hope these data were not used in the wildlife monitoring section that follows.	The species included in the table is based on BLM sensitive species that are noted as present in the Natural Heritage Database for each stretch of the project area. Additionally, professional opinion was used to supplement some of the findings. This allowed for consistent methodology for determining which species might be present and therefore impacted by the alternatives. We acknowledge that Natural Heritage Data is not comprehensive. The sources cited by the commenter were reviewed and the EIS has been updated, where needed.

Letter Number	Letter Comment Number	Comment Code	Comment Text	Response
306	28	WILDTERR - Terrestrial Wildlife	Table G-1: Multple landscape designations are erroneous and multiple species are not represented in this table, as indicated for Section 3.12 as mentioned previous. However, several statements about the impacts of alternatives are either wrong or lack justification. 1) The claim that the alternatives do not affect speckled dace (Rhinichthys osculus) because it is "...found in the tributaries" is inaccurate. This species breeds in the tributaries during the summer months, but moves into the mainstream during winter, where their biology remains unknown. 2) Peregrine falcons feed primarily on waterbirds during their summer seasonal occupation of Grand Canyon (Stevens et al. 2009). There are insufficient data at present to understand the status of that population, as well as what impact the alternatives will have. 3) White pelicans are brief and erratic migrants onto Lake Powell and also have been observed in Grand Canyon on quite a few occasions; however, there are no data that indicate differential impacts between alternatives on that species.	The species included in the table are based on BLM sensitive species that are noted as present in the Natural Heritage Database for each stretch of the project area. Additionally, professional opinion was used to supplement some of the findings. This allowed for consistent methodology for determining which species might be present and therefore impacted by the alternatives. The supplemental EIS incorporates the original EIS by reference, which goes into greater detail of impacts. Pelicans are listed as being potentially impacted by alternatives. There is no data that indicates an impact from the alternatives to peregrine falcons. Information regarding speckled dace was updated
310	6	WILDTERR - Terrestrial Wildlife	Another deficiency of Table 1-1 (p. 1-14) is its selectivity in including only certain groups of living organisms in its scope. Which plants are included is selective, and there is a bias in including only vertebrate animals. Even among the birds, raptors and waterfowl are the only "taxa" listed. The only invertebrates to make it into the analysis are special status species. Occasionally algae are mentioned. The RDSEIS needs to include all of life's kingdoms, including those that are no longer classified as plants or animals. The specific taxonomy Reclamation uses is less important than the fact that all kingdoms are included. The ecosystem functions as a whole, with each of its constituents playing a role, and Reclamation needs to assess how all such constituents (species, if you prefer) are affected by Reclamation's No Action Alternative and Proposed Action. The RDSEIS claims on several pages that " . . . given that the predicted flows are only marginally different, no population level impacts are expected . . ." (e.g., RSDEIS, p. 3-319). On what factual basis does Reclamation support this statement? We find none. In assessing effects of the Proposed Action on vegetation, wildlife in general and special status species in particular within the river segment from Hoover Dam to the SIB, Reclamation repeatedly states that the Proposed Action will have a greater impact than the No Action Alternative (RSDEIS, pp. 3-201, 3-202, 3-203, 3-218, and 3-219). Reclamation points out that the Proposed Action would have a greater impact on backwaters in general and on the bonytail population on the Cibola National Wildlife Refuge in particular (p. 3-202) and on marsh vegetation. What is left unsaid is that marshes along this stretch of the river are habitat for the endangered Yuma Ridgway's Rail. This issue needs to be openly addressed by Reclamation. How does Reclamation propose to mitigate these losses if the impacts can't be avoided?	It is not feasible to analyze population level effects on microorganisms because of their vast diversity and general lack of data for the majority of these taxa at landscape scales. The analysis in the RSDEIS is based on hydrologic modeling. When hydrologic models indicate that conditions under a certain alternative would be similar to existing conditions, it is reasonable to determine that populations of various species under the modeled alternative would have similar population levels as they do under existing conditions. The BA quantifies impacts on marshes and conservation measures to reduce those impacts. Added text indicating that up to 41 acres of marsh and 133 acres of cottonwood-willow habitat could be affected. Added text indicating that Reclamation has proposed measures, which will be finalized through Section 7 consultation, to offset these losses.

Letter Number	Letter Comment Number	Comment Code	Comment Text	Response
310	10	WILDTERR - Terrestrial Wildlife	There is another listing of special status species that Reclamation appears not to have consulted for the RDSEIS. Each state in the Colorado River Basin has a State Wildlife Plan. Each of these plans has a listing of Species of Greatest Conservation Need (SGCN). Reclamation needs to include these species in the analysis of impacts on wildlife and vegetation. Each of the seven Basin states' wildlife agencies should be able to provide this list to Reclamation. We strongly recommend that in future scoping and draft environmental documents (EIS, EA) Reclamation refer to these lists of SGCN in the document and assess the impacts of the alternatives on these species as well as those that Reclamation has included in the RDSEIS.	Each State independently develops their State Wildlife Action Plan and criteria for species inclusion varies by state. A regional SGCN list is not available at this time. To ensure consistency across multiple states, the BLM special status species list for each field office was used to determine which species to analyze in the SEIS. While each state has different BLM sensitive species, the methodology for identifying those species is consistent across the analysis area.
326	21	WILDTERR - Terrestrial Wildlife	[Section 3.13, page 3-185] Yuma Ridgway's rail also occur in wetlands downstream of agricultural drains on exposed lakebed surrounding the Salton Sea. Please include a discussion of the occurrence of Yuma Ridgway's rail in these wetland areas. The Service's biological opinion for the Salton Sea 10-Year Management Program, issued to the Army Corps on February 23, 2023, can provide baseline Yuma Ridgway's rail occurrences in these locations.	Nothing considered in the SEIS Proposed Action is changing impacts from what has previously been analyzed for Salton Sea lakebed exposure by the USACE. While it may accelerate exposure, it will not change total exposure.
326	46	WILDTERR - Terrestrial Wildlife	[Section 3.13.2, page 3-197] "During this transitional period, there could be impacts on species that utilize riparian habitat." Describe the types of impacts and the species that would be affected.	The supplemental EIS incorporates the original EIS by reference, which goes into greater detail of impacts.
326	49	WILDTERR - Terrestrial Wildlife	[Section 3.13.2, page 3-198] "Most species that utilize riparian habitat in this area are likely habitat generalists that have adapted to changing riparian habitat availability.." Explain whether riparian-dependent species occur near Lake Mead, and if so, how would the No Action alternative affect them.	The supplemental EIS incorporates the original EIS by reference, which explains the limited and transitional nature of riparian habitat surrounding Lake Powell and Lake Mead. Text modified to make this reference clearer and to explain that impacts will be similar to those described in the 2007 FEIS for all species, whether generalists or riparian obligates, that use the riparian habitats around the lakes.
326	52	WILDTERR - Terrestrial Wildlife	[Section 3.13.2, page 3-200] "Therefore, the magnitude of the effects would be greater under the Proposed Action." I think what you want to say here is that the Proposed Action would have a low magnitude of effect on wildlife, because it would cause only small changes to wildlife habitat.	The last sentence of the referenced paragraph addresses the magnitude.
326	54	WILDTERR - Terrestrial Wildlife	[Section 3.13.2, page 3-201] "Impacts on riparian vegetation and terrestrial wildlife species would, therefore, be greater under the Proposed Action than the No Action Alternative." Explain what the impacts to terrestrial wildlife are under the Proposed Action. For example, the Proposed Action would lead to more loss of riparian vegetation than the No Action. The following species would be affected by this loss of habitat: X,Y,and Z.	While this section does go on to describe these impacts, including loss of vegetation, fragmentation of habitat, and impacts on fish due to reduced flows, additional information was added regarding quantified impacts on emergent marsh habitat
326	55	WILDTERR - Terrestrial Wildlife	[Section 3.13.2, tables 3-29 and 3-30 and 3-31] The EIS text on page 3-204 says the No Action could benefit bats, so add that information to Table 3-29. For American pelican, bald eagle, condor, and golden eagle, the "potential impacts" column is vague. Further explain the changes to open water and foraging area. For California black rail, the bats, and monarch butterfly, the "potential impacts" column vague. Add information about what the changes to riparian and foraging habitat are.	Information about impacts is located throughout the text. No change will be made to the table in order to keep it readable, but readers can reference the text for details.

Letter Number	Letter Comment Number	Comment Code	Comment Text	Response
484	21	WILDTERR - Terrestrial Wildlife	Proposed Action - Species Tables Why are there not species impacts tables similar to those in the No Action section (pg3-218)? See Tables 3-30 through 3-34.	Tables are not included in those sections because the type of impacts are the same across all alternatives. Only the magnitude of those impacts will differ, as discussed under each alternative. The table in the No Action Alternative discloses the species that would be present as well as the potential type of impacts that are likely under each alternative.

Appendix I

SEIS Biological Assessments

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Upper Basin Biological Assessment for the Supplemental Environmental Impact Statement of the 2007 Colorado River Interim Guidelines

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Acronyms and Abbreviations

°C	degrees Celsius
2007 Interim Guidelines	*Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead*
AZGFD	Arizona Game and Fish Department
BA	biological assessment
BO	biological opinion
CFR	Code of Federal Regulations
cfs	cubic feet per second
CRMMS	Colorado River Mid-term Modeling System
DCP	drought contingency plan
Department	U.S. Department of the Interior
DOI	U.S. Department of the Interior
DROA	Drought Response Operations Agreement
EIS	environmental impact statement
ESA	Endangered Species Act of 1973, as amended
GCDAMP	Glen Canyon Dam Adaptive Management Program
GCMRC	Grand Canyon Monitoring and Research Center
km	kilometer(s)
LCR MSCP	Lower Colorado River Multi-Species Conservation Program
LTEMP	Glen Canyon Dam Long-Term Experimental and Management Plan
maf	million acre-feet
mg/L	milligrams per liter
NEPA	National Environmental Policy Act
NPS	National Park Service
PBF	physical or biological features
PCE	primary constituent elements
Reclamation	U.S. Bureau of Reclamation
RM	river mile
ROD	Record of Decision
Secretary	Secretary of the Interior

SEIS	supplemental environmental impact statement
TSC	Technical Services Center
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

Introduction and Background

The Bureau of Reclamation (Reclamation) is responsible for operating Glen Canyon Dam of the Colorado River Storage Project as a multipurpose storage facility in northern Arizona. Construction and operation of the dam was authorized by the 1956 Colorado River Storage Project Act. Construction of the dam was completed in 1963, and the lake completed filling to the full pool elevation of 3,700 feet in 1980. Operation of the dam is influenced by a complex set of compacts, federal statutes and regulations, court decrees, and an international treaty collectively and commonly referred to as the Law of the River.

In December 2007, the U.S. Department of the Interior (DOI, or Department) signed the Record of Decision (ROD) for the Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead (2007 Interim Guidelines). The 2007 Interim Guidelines, which were anticipated to be in place for the interim period through 2026, provide operating criteria for Lake Powell and Lake Mead, including provisions designed to provide a greater degree of certainty to water users about timing and volumes of potential water delivery reductions, and additional operating flexibility to conserve and store water in the system. The 2007 Interim Guidelines adopted ranges of releases from Glen Canyon and Hoover Dams that were linked to reservoir elevations in Lake Powell and Lake Mead, respectively. The 2007 Interim Guidelines were adopted for a limited period ("interim") to provide an opportunity for Reclamation and interested entities to gain valuable experience for the management of Lake Powell and Lake Mead under modified operations, with the goal of improving the analytical basis for making future operational decisions, whether during the interim period or after.

The 2007 Interim Guidelines were used by the Secretary of the Interior (Secretary) to

- determine those circumstances under which the Secretary would reduce the annual amount of water available for consumptive use from Lake Mead to the Colorado River Lower Division states (Arizona, California, and Nevada) below 7.5 million acre-feet (maf) (a "Shortage") pursuant to Article II(B)(3) of the United States Supreme Court Decree in the case of Arizona v. California, 547 U.S. 150 (2006) (Consolidated Decree),
- define the coordinated operation of Lake Powell and Lake Mead to provide improved operation of these two reservoirs, particularly under low reservoir conditions,
- allow for the storage and delivery, pursuant to applicable federal law, of conserved Colorado River system and non-system water in Lake Mead to increase the flexibility of meeting water use needs from Lake Mead, particularly under drought and low reservoir conditions, and
- determine those conditions under which the Secretary may declare the availability of surplus water for use within the Lower Division states.

In 2016, Reclamation and the National Park Service (NPS) developed and implemented the Long-Term Experimental and Management Plan (LTEMP) for operations of Glen Canyon Dam (DOI 2016).[1] The LTEMP provides a framework for adaptively managing Glen Canyon Dam

[1] More information at: https://ltempeis.anl.gov/

operations through 2036 consistent with the Grand Canyon Protection Act of 1992 and other provisions of applicable federal law. The LTEMP environmental impact statement (EIS) provides a framework for managing dam operations, including hourly, daily, and monthly release patterns as well as non-flow, experimental, and management actions (DOI 2016). In accordance with the normal operations as described in the LTEMP, a minimum of 8,000 cubic feet per second (cfs) must be released between 7 a.m. and 7 p.m., and a minimum of 5,000 cfs must be released between 7 p.m. and 7 a.m. The daily range in mean hourly flows is limited to 10 times the monthly volume in June through August and 9 times the monthly volume in other months; under these rules, the daily range does not exceed 8,000 cfs. The up-ramp rate is limited to 4,000 cfs per hour, while the down-ramp rate is limited to 2,500 cfs per hour. Table 1 is taken from the LTEMP ROD and presents the monthly volumes under different hydrological conditions for annual volumes ranging from 7.0 to 14.0 maf per year. The LTEMP ROD also allows for operational flexibility to adjust daily and monthly releases for water distribution purposes, resource-related issues, hydropower-related issues, and other circumstances. These could include safety of dams, public health, emergency situations, or unforeseen activities arising from operating experience including, in coordination with the Basin States, actions to respond to low reservoir conditions as a result of drought in the Colorado River Basin. The LTEMP did not address operations for releases less than 7.0 maf per year. For this action, monthly releases from Glen Canyon Dam would be distributed proportionally across the remaining months of the water year for annual releases below 7.0 maf. An additional column (shaded) was added to Table 1 to demonstrate an example 6.0 maf yearly release pattern which is the lowest possible annual volume under the proposed action.

Table 1. Monthly Release Volumes under LTEMP with Example Release Pattern for 6.0 maf

	Monthly Release Volume (thousand acre-feet)										
Month	**6,000**	**7,000**	**7,480**	**8,230**	**9,000**	**9,500**	**10,500**	**11,000**	**12,000**	**13,000**	**14,000**
October	411	480	480	643	643	643	643	643	643	643	643
November	429	500	500	642	642	642	642	642	642	642	642
December	514	600	600	716	716	716	716	716	716	716	716
January	569	664	723	763	857	919	1,041	1,102	1,225	1,347	1,470
February	503	587	639	675	758	813	921	975	1,083	1,192	1,300
March	531	620	675	713	801	858	973	1,030	1,144	1,259	1,373
April	473	552	601	635	713	764	866	917	1,019	1,121	1,223
May	471	550	599	632	710	761	862	913	1,014	1,116	1,217
June	495	577	628	663	745	798	905	958	1,064	1,171	1,277
July	559	652	709	749	852	902	1,022	1,082	1,202	1,322	1,443
August	597	696	758	800	899	963	1,091	1,156	1,284	1,413	1,537
September	447	522	568	600	674	722	819	861	963	1,059	1,160

The Department has taken multiple steps to respond to historic drought and low-runoff conditions in the Basin since 2007, including several unprecedented and emergency actions since 2021:

- **2014 – System Conservation Pilot Program and Memorandum of Understanding for Lower Basin Drought Response Actions:** A 2014 agreement among Reclamation and the major municipal water providers (Denver Water, Central Arizona Water Conservation District, Metropolitan Water District of Southern California, and Southern Nevada Water Authority) in both the Upper and Lower Basin established a pilot program to fund the creation of Colorado River system water through voluntary, measurable reductions in consumptive use for the benefit of all users to help offset declining reservoir elevations.
- **2019 – Drought Contingency Plans (DCPs):** As approved by Congress, the DCPs provide a framework for additional actions to help the Basin adapt to drought. The Upper Basin DCP is designed to reduce the risk of reaching critical elevations at Lake Powell, help assure continued compliance with the Compact, and facilitate and encourage storage of conserved water in the Upper Basin that could help establish the foundation for a demand management program that may be developed in the future. The Lower Basin DCP is designed to require additional contributions of water to Lake Mead storage at predetermined elevations and create new flexibility to incentivize additional voluntary conservation of water to be stored in Lake Mead.
- **2021 – Emergency Drought Response Operations Agreement (DROA) Releases:** Consistent with DROA provisions to protect Lake Powell's target elevation, Reclamation increased releases from the upstream initial units of the CRSP to deliver an additional 181,000 acre-feet of water to Lake Powell by the end of December 2021.
- **2021 – 500 Plus Plan:** Recognizing the history of low-runoff conditions and the variability of flows in the Basin, workgroups concluded an additional 500,000 acre-feet or more per year of additional reductions in water use were required. The plan was to conserve additional water above what is required under a Lower Basin shortage condition and contributions under the Lower Basin DCP. The 500 Plus Plan's parties identified and are funding projects in each of the three Lower Division States. The projects include Tribal, agricultural, and municipal water users.
- **2022 – Drought Response Operations and 480,000 acre-feet Reduced Lake Powell Release:** On May 3, 2022, Reclamation announced two separate drought response actions to help increase Lake Powell storage by nearly 1.0 maf from May 2022 through April 2023. These actions were (1) releasing approximately 500,000 acre-feet of water from Flaming Gorge Reservoir under the DROA and (2) holding 480,000 acre-feet in Lake Powell by reducing Glen Canyon Dam's annual release volume from 7.48 maf to 7.00 maf.
- **2022/2023 – Lower Colorado and Upper Colorado System Conservation and Efficiency Programs:** The programs were created to address the unprecedented drought in the Basin and are part of the commitment made by the Department on August 16, 2022, to address the drought crisis with prompt and responsive actions and investments to create programs and improve water management efforts across the Basin.

While these actions, especially the DCPs, were intended to preserve Reclamation's ability to undertake post-2026 operational planning with a stable system and avoid crisis planning, Colorado River water supplies continue to decline, resulting in historically low reservoir levels at Lake Powell and Lake Mead. Following adoption of the DCPs in 2019, the Basin experienced

three of the lowest consecutive years of inflow on record from 2020 through 2022, with 2021 among one of the lowest inflow years on record. During this time, the combined storage of Lake Powell and Lake Mead declined from about 50% to 25% of total live capacity.

Due to an above average snowpack in winter 2023, inflows were larger than expected resulting in Lake Powell increasing 65 feet to its peak elevation of 3,584.71 feet on July 10, 2023. Based on hydrologic conditions in April 2023, the most probable inflow into Lake Powell was projected to be 11.3 maf (177% of average) during the 2023 April-July runoff period. Reclamation adjusted the release from 7.0 maf up to 9.5 maf from Lake Powell in April 2023 consistent with Section 6.D.1 of the Interim Guidelines and adjusted monthly based on actual hydrology and reservoir conditions. Reclamation also removed the operational neutrality of the 480,000 acre-feet that was retained in Lake Powell in 2022, such that balancing releases were based on physical elevations of Lake Powell and Lake Mead.

The 2023 hydrologic conditions improved live capacity to approximately 35%. However, absent a meaningful change in hydrologic conditions and trends, water use patterns, or both, Colorado River reservoirs could continue to decline to critically low elevations, threatening essential water supplies across seven states in the United States and two states in the Republic of Mexico. It is foreseeable that without appropriate responsive actions and under a continuation of recent hydrologic trends, major Colorado River reservoirs could continue to decline to "dead pool" in the coming years. Current operational guidelines do not allow annual releases below 7.0 maf. To address these potential conditions, Reclamation is preparing a supplemental EIS (SEIS) to the 2007 Interim Guidelines to modify operating guidelines for Glen Canyon and Hoover Dams to address the historic drought and low-runoff conditions in the Colorado River Basin. The need for the revised operating guidelines is based on the potential that continued low-runoff conditions in the Colorado River Basin could lead to critically low reservoir conditions at Lake Powell and Lake Mead that impact both water delivery and hydropower operations in the next few years.

Action

Under the proposed action, the annual Lake Powell release is based on the volume of water in storage or the corresponding elevation of Lake Powell and Lake Mead, as described in the operational tiers below (Table 2). The applicable operational tier is based on the August 24-Month Study projections of the January 1 system storage and reservoir water surface elevations for the following operating year.

The Equalization and Upper Elevation Balancing Tiers are the same as under the 2007 Interim Guidelines. The Mid-Elevation Release Tier and Lower Elevation Balancing Tier are also the same as the 2007 Interim Guidelines, with the exception that Reclamation may reduce releases to a minimum release of 6.0 maf if any minimum probable Lake Powell elevation projection shows Lake Powell < 3,500 feet over next 12 months. In April, when in Mid-Elevation Release Tier and Lower Elevation Balancing Tier, if Lake Powell is projected to drop below 3,500 feet by the end of the water year or is already below 3,500 feet, monthly releases are reduced to minimize months below 3,500 feet while releasing up to the original release, and no less than 6.0 maf, with a minimum daily release defined by the LTEMP.

Table 2. Lake Powell Operational Tiers for the Proposed Action (Table 2-5 of SEIS)

Lake Powell Operational Tiers (subject to April adjustments or mid-year review modifications)		
Lake Powell Elevation (feet)	**Lake Powell Operational Tier**	**Lake Powell Active Storage*** (maf)
3,700	**Equalization Tier** Equalize, avoid spills, or release 8.23 maf	**23.31**
3,636–3,666 (see Table 2.3-1 in the 2007 FEIS)	**Upper Elevation Balancing Tier** Release 8.23 maf; if Lake Mead <1,075 feet, balance contents with a minimum/maximum release of 7.0/9.0 maf	**14.65–18.36** (2008–2026)
3,575	**Mid-Elevation Release Tier** Release 7.48 maf; if Lake Mead <1,025 feet, release 8.23 maf If any minimum probable Lake Powell elevation projection shows Lake Powell <3,500 feet over the next 12 months, reduce releases to a minimum of 6.0 maf to maintain an elevation of 3,500 feet	**8.90**
3,525	**Lower Elevation Balancing Tier** Balance contents with a minimum/maximum release of 7.0/9.5 maf If any minimum probable Lake Powell elevation projection shows Lake Powell <3,500 feet over the next 12 months, reduce releases to a minimum of 6.0 maf to maintain an elevation of 3,500 feet	**5.55**
3,500	The Secretary reserves the right to operate Reclamation facilities to protect the Colorado River system if hydrologic conditions require such action	**4.22**
3,370		**0**

*Active storage values have been updated from 2007 based on the 2018 bathymetry.

Whenever Lake Mead's content is projected to be below an elevation of 1,025 feet, based on the April 24-Month Study minimum probable projection, the Lower Division States will have 45 calendar days to provide Reclamation with an implementation plan to protect Lake Mead

from reaching an elevation of 1,000 feet. If an implementation plan is not acceptable to Reclamation, then Reclamation may take additional action to protect 1,000 feet.

The LTEMP biological opinion (BO) (U.S. Fish and Wildlife Service [USFWS] 2016) considered monthly, daily, and hourly operations based on annual release volumes listed in the 2007 Interim Guidelines with minimum annual releases of 7.0 maf. Because monthly, hourly, and daily releases below 7.0 maf per year were not analyzed in the LTEMP EIS or biological assessment (BA), the action for this BA is specific to operations of Glen Canyon Dam when annual releases are <7.0 maf. The proposed action in this BA describes scenarios that include adjustments to reduce the annual Glen Canyon Dam release volume to no less than 6.0 maf while maintaining LTEMP minimum flows, operational constraints, and prudent operation as determined by Reclamation to maintain an elevation of 3,500 feet.

Based on modeling results, the elevation of Lake Powell is not expected to decrease to 3,500 feet in 2024 or 2025, but it occurs in 2% of the traces in 2026. However, the modeling assumptions do not include DROA actions, which if implemented could further reduce the likelihood of a 6.0 maf release. Although it is not likely to occur, it is possible that a 6.0 maf year could occur in 2026, and this BA serves to seek coverage for a 6.0 maf year. This BA was prepared by Reclamation as part of its compliance with the Endangered Species Act of 1973, as amended (ESA) (87 Statute 884; 16 United States Code 1531 et seq.).

While the proposed action in this BA is directed at this interim period, Reclamation has already initiated the National Environmental Policy Act (NEPA) process to address long-term Colorado River operations (i.e., post-2026). In concert with the NEPA process, Reclamation will collaborate with the USFWS on long-term compliance under the ESA and, when appropriate, will reinitiate formal consultation. Reclamation's Lower Colorado River Multi-Species Conservation Program (LCR MSCP) anticipated that changes in Lake Mead reservoir elevations could result in impacts to the Colorado River inflow area, and these impacts are covered for Lake Mead reservoir elevations between 950 feet and full pool elevation (1,229 feet). These impacts are also reanalyzed in a separate BA.

Action Area

The action area for this proposed federal action begins with Lake Powell and extends downstream along the Colorado River floodplain to the Southerly International Boundary with Mexico. This area includes the full pool elevation of Lake Powell (3,700 feet), Glen Canyon Dam, and the river downstream to Lake Mead and Hoover Dam (Figure 1).

This BA covers the area from full pool elevation of Lake Powell (3,700 feet) to below Glen Canyon Dam to Pearce Ferry Rapid (river mile [RM] 281) (Figure 2). Water quality effects on Lake Mead from Glen Canyon Dam releases are also evaluated here. A separate BA covers the area immediately below Pearce Ferry Rapid including the inflow area downstream to the Southerly International Boundary with Mexico. It also evaluates any effects on species in the Grand Canyon caused by elevation changes of Lake Mead.



Figure 1. Locations of Glen Canyon Dam, Lake Powell, and the Colorado River between Lake Powell and Lake Mead, and adjacent lands to the border of Mexico.

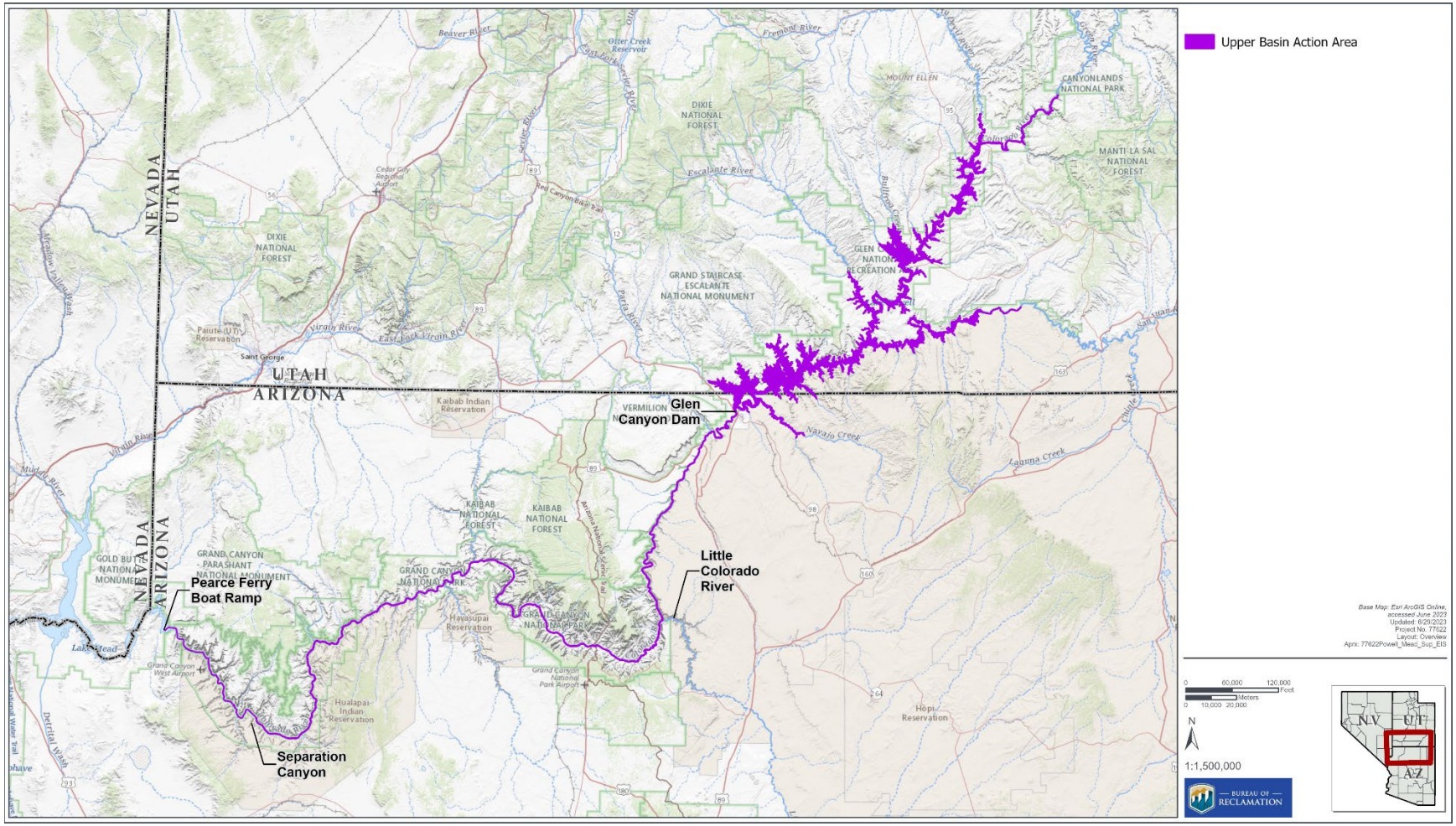


Figure 2. The action area covered by this BA.

Species Identified for Analysis

Five species are addressed in this BA due to potential effects from the proposed action: humpback chub (*Gila cypha*), razorback sucker (*Xyrauchen texanus*), Colorado pikeminnow (*Ptychocheilus lucius*), southwestern willow flycatcher (*Empidonax traillii extimus*), and western yellow-billed cuckoo (*Coccyzus americanus*).

Reclamation made "no effect" determinations for the Mexican spotted owl (*Strix occidentalis lucida*), Yuma Ridgway's rail (formerly Yuma clapper rail) (*Rallus obsoletus yumanensis*), and sentry milk-vetch (*Astragalus cremnophylax* var. *cremnophylax*) because none of these species, or their habitat, occur in the area where activities would be implemented, and thus they are not considered further in this analysis. The California condor (*Gymnogyps californianus*) is an endangered species that would not be affected by this action, and the condors released in Arizona are designated as a non-essential, experimental population under the 10(j) rule of the ESA; thus, condors are not considered further in this analysis.

The bonytail (*Gila elegans*) was classified as endangered in 1980 (Federal Register 45:27710–27713), with critical habitat designated in 1994 (Federal Register 59:13374–13400). Recovery goals for the bonytail were approved in 2002 (Federal Register 67:55270–55271). The life history of the species is described in the recovery goals (USFWS 2002a). Although there is not a self-sustaining population in Lake Powell, untagged bonytail have recently been released in the lake; the bonytail were produced at the Wahweap hatchery by random spawning in the ponds and released into the lake (Badame 2023; Smith 2022). Because they were released untagged, it is not possible to assess the effect of the action on the fish. Additionally, because the fish are released as juveniles, it is not anticipated that bonytail would persist to be affected by the proposed action. A single untagged *Gila* spp. was captured in Lee's Ferry below the dam in July 2023 which, although identification has not yet been confirmed, was likely one of the bonytail that was released in Lake Powell and likely passed through the dam when the elevation of the reservoir was low. For these reasons described above, Reclamation has made a "no effect" determination for bonytail.

Humpback Chub

Legal Status and Recovery Goals

The humpback chub, a fish endemic to the Colorado River Basin of the southwestern United States, was listed as endangered on March 11, 1967 (Federal Register 32:4001), and the USFWS designated critical habitat in 1994 (Federal Register 59:13374–13400). The *Humpback Chub Recovery Plan* was approved in 1990 (USFWS 1990) and was revised and supplemented by the 2002 *Humpback Chub (Gila cypha) Recovery Goals* (USFWS 2002b). The recovery goals were withdrawn and declared of no force and effect by court order on January 18, 2006 (Grand Canyon Trust et al. vs. Gale Norton et al., United States District Court for the District of Arizona. Order No. 04-CV-636-PHX-FJM). The most recent 5-year review of the species status and the species status assessment was completed in 2018 and included a recommendation to reclassify the humpback chub from endangered to threatened (USFWS 2018a). The humpback chub was reclassified from endangered to threatened on October 18, 2021 (Federal Register 86:57588–57610).

Threats

The primary threats to humpback chub include habitat loss, habitat modification, streamflow regulation, predation by nonnative fish, parasitism, pesticides, and pollutants (USFWS 2018a). In addition to these known threats are potential threats that have not been fully evaluated: hybridization with other *Gila* sp.; competition with native and nonnative species of fish; and overpopulation of other fish species that alter habitat conditions.

Habitat loss/modification and streamflow regulation have resulted in local extirpations and a contracted range for humpback chub (Minckley 1973; USFWS 2018a). Nonnative predators can cause higher levels of mortality for humpback chub (albeit for different life stages: eggs, larvae, young, and/or adult) and these include rainbow (*Oncorhynchus mykiss*) and brown trout (*Salmo trutta*), smallmouth bass (*Micropterus dolomieu*), green sunfish (*Lepomis cyanellus*), largemouth bass (*M. salmoides*), walleye (*Sander vitreus*), striped bass (*Morone saxatilis*), black crappie (*Pomoxis nigromaculatus*), burbot (*Lota lota*), northern pike (*Esox lucius*), common carp (*Cyprinus carpio*), and channel catfish (*Ictalurus punctatus*) (NPS 2013; Ward and Vaage 2019; Yard et al. 2011). Warmwater parasites of humpback chub (Asian tapeworm [*Bothriocephalus acheilognathi*] and a parasitic copepod [*Lernaea cyprinacea*]) may affect body condition and, eventually, survival of individuals (Flagg 1982; Hoffnagle et al. 2006), but no known outbreak has occurred that has dramatically affected an entire population. Pesticide exposure can cause spinal deformities in fish populations, and though no tissue analysis has been conducted with humpback chub, spinal deformities have been observed in the Upper Basin (Francis et al. 2016). Catastrophic spills of hazardous materials, such as petroleum products or other chemicals are a potential threat to water quality and to humpback chub though no specific fish kills have been identified historically (USFWS 2018a). Humpback chub can hybridize with roundtail chub (*Gila robusta*) or bonytail, but this is not a concern in the action area.

Historical and Current Range

The humpback chub is a large cyprinid endemic to the Colorado River system. The historic range of the species included canyon-bound riverine sections within the Colorado River watershed spanning many states; however, humpback chub currently occupies only 68% of its historic range. This species is restricted to six populations between the Upper and Lower Basins (USFWS 2020a). Historic and current range of the humpback chub has been previously documented and additional information on its range can be found in the LTEMP EIS (DOI 2016), species status assessment (USFWS 2018b), and recovery goals (USFWS 2002b).

Distribution

Translocations of humpback chub to Shinumo Creek occurred from 2009 to 2013 but were suspended following a fire and subsequent flood. However, humpback chub that were translocated to Shinumo Creek are still detected in the aggregation adjacent to the creek.

Juvenile humpback chub were translocated to Havasu Creek annually from 2011 through 2016, and evidence of reproduction has been observed since 2012. The abundance estimate in 2022 was 145 (95% confidence interval: 138–170), and population estimates indicate a stable population (NPS 2022a).

Translocations of humpback chub to Bright Angel Creek first occurred in 2018 and again in 2020. To date, 531 of 1,000 humpback chub have been translocated. Initial survival estimates are low (3%–11%) (NPS 2022a); however, additional translocations are planned over the next couple of years.

The population of humpback chub in the Grand Canyon recently expanded downstream into what is referred to as western Grand Canyon (i.e., Havasu Rapid [RM 157] to Pearce Ferry Rapid [RM 281]). Evidence of recruitment and population expansion was documented in 2016 (Van Haverbeke et al. 2017). The abundance of humpback chub in western Grand Canyon in 2022 was estimated as 40,000 to 60,000 subadults and adults (Dzul et al. 2023).

Life History

The life history of the humpback chub was previously documented in the LTEMP EIS (DOI 2016), species status assessment (USFWS 2018b), and recovery goals (USFWS 2002b).

Habitat

No new information is provided on humpback chub habitat since the LTEMP EIS was completed (DOI 2016). Humpback chub habitat was previously documented in the LTEMP EIS (DOI 2016), species status assessment (USFWS 2018b), and recovery goals (USFWS 2002b).

The humpback chub uses a variety of habitats from nearshore shallow rocky areas to deep waters. Habitat use is dependent on life stage, and an ontogenetic shift to deeper water habitat occurs as fish grow (Bulkley et al. 1981). Larvae use nearshore low-velocity nursery habitat (Gorman 1994; Valdez and Ryel 1995, 1997). Spawning habitat is characterized as complex, often with rocky substrates. The habitat in the western Grand Canyon where the population of humpback chub has recently become established is dynamic and continues to change as the river continues to carve through the deltaic sediment deposits.

Critical Habitat

Critical habitat was designated for humpback chub on March 21, 1994 (Federal Register 59:13374–13400), including about 164 miles (264 kilometers [km]) of the Colorado River in Grand Canyon from Nautiloid Canyon (RM 35) to Granite Park (RM 208). Critical habitat in the Little Colorado River extends from RM 8 (13 km) to the confluence with the Colorado River. Water quantity and quality and associated fish habitat in the Little Colorado River are affected primarily by perennial springs in the lower sections and seasonally by runoff from tributaries in the upper sections. The areas typically used for spawning are likely too far from the confluence to be affected by changes to the Colorado River. Humpback chub evolved with lower flows in the Colorado River and reduced flows through the dam that would occur with the proposed action would more closely mimic the pre-dam dry season.

Population within the Action Area

Most spawning in the Lower Basin population occurs in the lower section of the Little Colorado River, which is a tributary that enters the Colorado River at RM 61 (Dzul et al. 2016). Population estimates of humpback chub in the Colorado River between 30-mile Spring and Havasu Creek suggest approximately 14,000 adults make up the core population of humpback chub (USFWS

2018a, 2021). Humpback chub recently expanded into the western Grand Canyon, and evidence of recruitment was first observed in 2017 (Van Haverbeke et al. 2017). In 2022, the population of humpback chub in the western Grand Canyon was estimated at 40,000 to 60,000 adults between Havasu Creek and Pearce Ferry Rapid (U.S. Geological Survey [USGS] 2023a). The population of humpback chub in the Little Colorado River has been quantified with a demographic model that provides estimates of the numbers of fish in the Little Colorado River, as well as the numbers of fish migrating to and from the Colorado River mainstem on an annual basis (Yackulic et al. 2014).

Humpback chub were translocated to Shinumo Creek from 2009 to 2013, to Havasu Creek from 2011 to 2016, and to Bright Angel Creek in 2018 and 2020. Evidence of reproduction has been observed in Havasu Creek, and the abundance estimate in 2022 was 145 (95% confidence interval: 138–170) (NPS 2022a).

Translocations of humpback chub to Bright Angel Creek first occurred in 2018 and again in 2020. To date, 531 of 1,000 humpback chub have been translocated. Initial survival estimates are low (3%–11%) (NPS 2022a); however, additional translocations are planned over the next couple of years.

Factors Affecting Distribution and Abundance in the Grand Canyon

Factors affecting distribution and abundance of humpback chub were discussed in the LTEMP EIS (DOI 2016). While the factors discussed in the EIS remain relevant, the proposed action may result in reduced flows downstream of Glen Canyon Dam. This reduction in flows is likely to affect humpback chub that are in the mainstem, especially when they use shoreline habitat during early life stages. Humpback chub are a warmwater fish and are likely to benefit from the warmer dam releases, because ideal temperatures range from 18 to 22 degrees Celsius (°C) (USFWS 2002b). However, if that temperature increase results in an increase in warmwater predators, negative effects due to humpback chub would be expected due to predation and competition.

The continued low lake levels in Lake Mead have supported an expansion of humpback chub into the western Grand Canyon downstream of Separation Canyon (full pool elevation of Lake Mead). The expansion is likely due in part to the newly carved river channel but primarily due to warmer temperatures and lack of predators since Pearce Ferry Rapid has evolved into a partial barrier to upstream movement of nonnative fish predators. Impacts to humpback chub were evaluated in the 2004 LCR MSCP BA (LCR MSCP 2004) and 2005 LCR MSCP BO (USFWS 2005), and coverage for those impacts is included for Lake Mead reservoir elevations between 950 feet and full pool but are also evaluated in this BA.

Razorback Sucker

Legal Status and Recovery Goals

The razorback sucker was listed as endangered in 1991 (Federal Register 56:54958), and critical habitat was designated on March 21, 1994 (Federal Register 59:13374–13400), which includes the Colorado River and its 100-year floodplain from the confluence with the Paria River (15 miles [24 km] downriver of Glen Canyon Dam) downstream to Hoover Dam, and from Hoover Dam to Davis Dam. The *Razorback Sucker (Xyrauchen texanus) Recovery Plan* was

approved in 1998 (USFWS 1998) and was amended and supplemented by the *Razorback Sucker (Xyrauchen texanus) Recovery Goals* (USFWS 2002c). The USFWS recently completed a species status assessment and 5-year status review, which concluded that the current risk of extinction for the razorback sucker is low and the species is no longer in danger of extinction (USFWS 2018a). A Section 4(d) Rule proposed in 2021 proposes to reclassify the razorback sucker from endangered to threatened (Federal Register 86:35708–35728). However, a decision on the reclassification is pending.

Historical and Current Range

The razorback sucker is endemic to large rivers of the Colorado River Basin from Wyoming to Mexico; however, the species' range has been substantially reduced (Marsh et al. 2015). Currently, it occurs in the Green River, Upper Colorado River, and San Juan River Subbasins; the Lower Colorado River between Lake Havasu and Davis Dam, Lake Mead and Lake Mohave; and tributaries of the Gila River Subbasin (USFWS 2002c) and the inflows to Lake Powell (Francis et al. 2017; Pennock, McKinstry, et al. 2020; Pennock et al. 2021).

Estimates of razorback sucker populations were summarized by Marsh et al. (2015) and Pennock et al. (2023), but the authors noted that the precision of many estimates was questionable given low recapture rates of marked individuals. The number of razorback suckers in the Colorado River Basin is only a fraction of historical populations and is primarily maintained by stocking, with the exception of the Lake Mead population (Albrecht et al. 2010; Albrecht et al. 2017; Marsh et al. 2015; Pennock et al. 2023). Recruitment has been occurring since the 1970s, sustaining the small population remaining in Lake Mead (Albrecht et al. 2010; Albrecht et al. 2017; Mohn et al. 2015; Pennock, McKinstry, et al. 2020; Pennock, McKinstry, and Gido 2020; Pennock et al. 2023; USFWS 2012). Lake Mead contains one of the smaller populations across the razorback sucker's range; however, recruitment is rare or nonexistent in other populations (Marsh et al. 2015).

Life History

No new information is provided on the life history of the razorback sucker beyond what was described in the LTEMP EIS (DOI 2016). Life history of the razorback sucker was previously documented in the LTEMP EIS (DOI 2016), species status assessment (USFWS 2018c), and recovery goals (USFWS 2002c).

The following provides an overview of the life history of the razorback sucker. The razorback sucker is a large river sucker (Family Catostomidae) endemic to the Colorado River system. It is a large fish, with adults reaching lengths up to 3 feet and weighing as much as 13 pounds (USFWS 2002c). The razorback sucker matures in 2 to 5 years and may live up to 40 years (USFWS 2018c). Spawning in rivers occurs over cobble bars, gravel bars, and sand substrates during spring runoff at widely ranging flows and at water temperatures as low as 6°C (Marsh 1985) but typically greater than 14°C (USFWS 2002c). High flow and temperature cues during spring are thought to be important to the initiation and success of spawning (USFWS 2002c). Vegetated floodplains, large backwaters, and other off-channel habitats inundated by spring high flows provide warmer, food-rich rearing habitats for drifting larval razorback sucker (Modde et al. 2001). High flows may also have flushed fine sediment from cobble bars, maintaining

interstitial space for egg deposition and incubation. In reservoirs, spawning occurs over wave-swept rocky shoals and shorelines.

Historically, this species exhibited upstream migrations in spring for spawning, although current populations include groups that are sedentary and others that move extensively (Minckley et al. 1991; USFWS 2018c). Adults in the Green River Subbasin have been reported to move as far as 62 miles [100 km] to specific areas to spawn (Tyus and Karp 1990). In Lake Mohave, individuals have moved 12 to 19 miles [19–31 km] between spring spawning and summer use areas (Mueller et al. 2000). Razorback suckers that were sonic-tagged and then released in the Grand Canyon and Lake Mead either stayed near spawning areas or moved up to 224 miles (361 km) within the western Grand Canyon, the Colorado River inflow to Lake Mead, and throughout the lake (Kegerries et al. 2015). Razorback suckers have also been documented to move from the San Juan inflow of Lake Powell to the Colorado River inflow and upstream over 100 miles (161 km) (Durst and Francis 2016).

Razorback suckers have high fecundity, with the average number of eggs per female ranging from 27,614 to 103,000 in various studies (USFWS 2002c). Eggs are incubated for 6 to 7 days before hatching, prior to emerging from cobbles and being transported downstream to floodplains or backwaters (USFWS 2018c). Hatching success is temperature dependent, with the potential for complete mortality occurring at temperatures less than 10°C (Bozek et al. 1990; Marsh 1985). Hatching success is highest between 15°C and 20°C (Bozek et al. 1990; Marsh 1985).

In the western Grand Canyon, the estimated onset of spawning is mid-February, based on calculation from the dates of collection of larval samples in 2014 and 2015, when average daily water temperatures were between 10°C and 12°C (Kegerries et al. 2015). Spawning appeared to peak toward the end of March when water temperatures ranged from 12°C to 14°C, but the duration of spawning was protracted, occurring between mid-February and July (Gilbert et al. 2022; Kegerries et al. 2015).

Once the larvae hatch, survival is highly dependent on environmental factors, including water temperature, and productive habitats sheltered from predators. At warmer water temperatures, growth rates are faster (Bestgen 2008) and thought to increase survival by minimizing the time larval fish are susceptible to predation by small-bodied fish. Also, turbidity can provide cover for the larvae from sight predators but may not be as effective against nocturnal predators, such as channel catfish (Pennock et al. 2021). In the Green River, larval razorback sucker may drift into low-velocity, warm backwaters or floodplain wetlands to rear, whereas, in the Lower Basin, spawning often takes place along lake shorelines or in large backwaters where the larvae remain.

Both adults and immature fish are omnivorous, feeding on algae, zooplankton, and aquatic insect larvae; however, diet varies by life stage. In Lake Mohave, the razorback sucker's diet has been reported to be dominated by zooplankton, diatoms, filamentous algae, and detritus (Marsh 1987). Larval razorback sucker feed on planktonic organisms, switching to benthic organisms as their subterminal mouth develops, with chironomid larvae being a primary food item (USFWS 2002c).

Habitat

Razorback suckers use a wide variety of habitats, including rivers and streams and their associated floodplains, as well as reservoirs (Valdez et al. 2012). Habitat use varies by life stage and habitat type (i.e., lentic vs. lotic habitats). In rivers, habitat requirements of adults in spring include low-velocity runs, eddies, backwaters, and areas of inundated vegetation (e.g., flooded off-channel areas); in summer, runs and mid-channel bars; and in winter, low-velocity runs, pools, and eddies (Valdez et al. 2012). Razorback suckers spawn on cobble and gravel bars in rivers, and on gravel and cobble shorelines in reservoirs. In reservoirs, adults prefer areas with water depths of ≥3 feet over sand, mud, or gravel substrates. Young require nursery areas with quiet, warm, shallow water such as tributary mouths, backwaters, and inundated floodplains along rivers and coves or shorelines in reservoirs (USFWS 2002c). The few larval razorback suckers that have been detected in the Grand Canyon appear to use isolated pools and backwaters (Albrecht et al. 2014; Kegerries et al. 2015). Larval razorback sucker may drift along the shoreline adjacent to the main channel until settling into warmer, shallow backwaters or floodplain wetlands (Valdez et al. 2012).

Critical habitat

Critical habitat within the action area includes the Colorado River from its confluence with the Paria River downstream to Hoover Dam, including the full pool elevation of Lake Mead (Federal Register 59:13374–13400). It also includes the Colorado River inflow from the full pool elevation of Lake Powell (3,700 feet) near Imperial Canyon downstream to the confluence of the Dirty Devil River (Federal Register 59:13374–13400).

Population Within the Action Area

Razorback suckers were thought to be extirpated from the Grand Canyon reach of the Colorado River since no adult or juvenile razorback suckers were observed from 1991 through 2011. However, in 2012 and 2013, two adult razorback suckers were captured upstream of Spencer Creek (RM 246), more than 25 miles (40 km) upstream from the termination of Grand Canyon at Pearce Ferry (Kegerries and Albrecht 2012). Larval razorback suckers were identified in channel margin habitats in 2014 and 2015, indicating that spawning has occurred in the mainstem river in the western Grand Canyon (Albrecht et al. 2014; Kegerries et al. 2015). Larval razorback suckers were collected in the Grand Canyon in 2014 (n=462), 2015 (n=81), 2017 (n=27), 2018 (n=10), and 2019 (n=8), but none have been detected since 2019 (Rogers et al. 2022). Larval and small-bodied fish sampling has occurred below Bright Angel Creek (RM 88) since 2014, and during that time, no small-bodied razorback suckers have been detected. Since there are so few razorback suckers and many flannelmouth suckers (*Catostomus latipinnis*), hybridization is a concern. The larval fish that were identified from 2014 through 2019 were preserved in a way that did not allow further analysis to determine whether they were pure razorback suckers or hybrids. Consequently, it is unknown whether the larval fish thought to be razorback suckers were actually hybrids.

In 2015, submersible ultrasonic receivers, which are devices that detect fish that have been implanted with a sonic tag, were installed upstream of Lava Falls (RM 179). No detections of tagged razorback suckers were recorded above Lava Falls through September 2015; however, the collection of larval fish upstream of Lava Falls (Kegerries et al. 2015) suggests spawning

occurred above Lava Falls. Sampling was expanded to just below Bright Angel Creek (RM 90) in 2016 to determine the upstream extent of razorback suckers (Kegerries et al. 2020).

Razorback suckers currently occur in Lake Mead (and the Colorado River upstream of Lake Mead), Lake Mohave, the Colorado River between Davis and Parker Dams (Lake Havasu), and the Colorado River below Parker Dam, although all populations except the Lake Mead population are maintained by stocking. Estimated abundances of razorback sucker in Lake Mead from 1997 to 2021 are shown in Figure 3 (Pennock et al. 2022). Estimates have ranged from fewer than 50 adults in 2001 to nearly 600 adults in 2011. Using a robust design, the population of razorback suckers was estimated for Lake Mead. Each year of sampling was treated as a primary period and groups of months within a year as secondary periods; the population was assumed to be closed within a year and open between years. Based on this approach the population abundance in Lake Mead was estimated at approximately 250 adults (Pennock et al. 2022; Pennock et al. 2023).

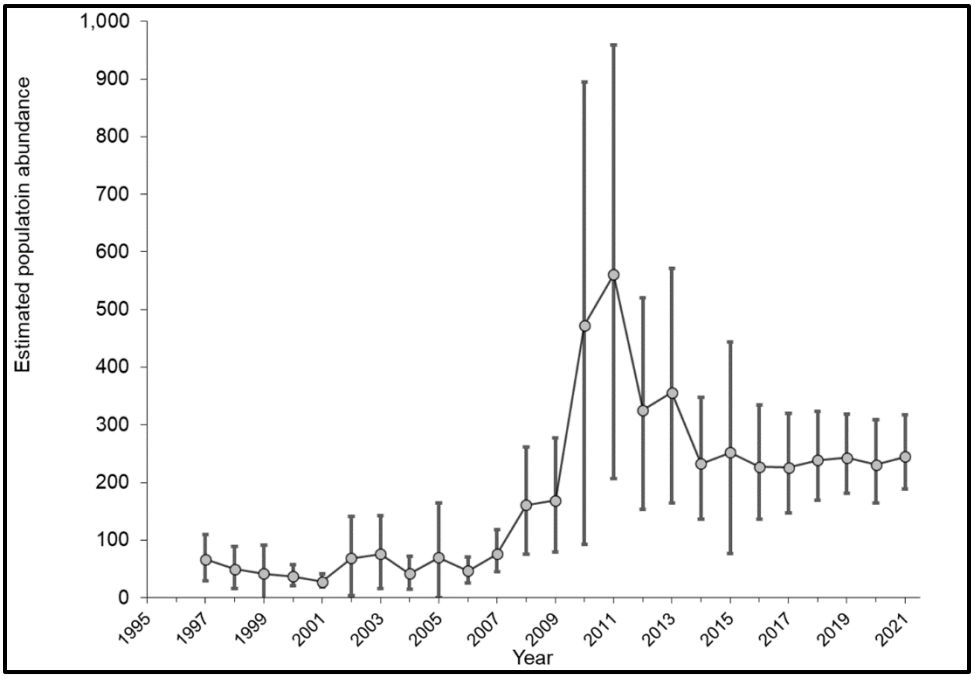


Figure 3. Estimated population abundance of razorback sucker in Lake Mead from 1997 through 2021 (Pennock et al. 2022).

Razorback suckers occupy the inflows of the San Juan and Colorado Rivers to Lake Powell, regardless of the level of the reservoir. The low elevation of Lake Powell over the last several years has created more riverine habitat and some razorback suckers have been detected in the inflow area which is part of the action area (Francis et al. 2017).

Factors Affecting Distribution and Abundance

The decline of the razorback sucker in the Grand Canyon and throughout its range has been attributed primarily to habitat modification due to dam construction (which resulted in cold water releases, habitat loss, and migration impediments), streamflow regulation, and predation by

nonnative fish species. All of these factors have resulted in a lack of recruitment (Gloss and Coggins 2005; USFWS 2002c, 2018c).

Spawning occurred in the Grand Canyon from 2014 through 2019, as evidenced by detection of larval razorback suckers (Rogers et al. 2022). The presence of razorback suckers and their use of habitats in the Grand Canyon have only recently been investigated, and it is unclear whether razorback sucker spawning occurred prior to larval and small-bodied fish monitoring initiated in the western Grand Canyon in 2014. There is also a question as to whether the larval fish that were detected were pure razorbacks or razorback-flannelmouth hybrids.

The Colorado River has been warmer over the last few years due to lower Lake Powell elevations, attributed to drought and consumptive water use; the warmer water is beneficial for many native species, including razorback suckers. Fish community composition in the lower river below Diamond Creek has changed dramatically from one dominated by nonnative species to one dominated by native species (Kegerries et al. 2015). The cause of the change in fish community composition is unknown. However, the decline in nonnative predator abundance in the western Grand Canyon coincides with the formation of Pearce Ferry Rapid as a partial barrier to upstream movement; this barrier combined with an extended river channel and warmer water temperatures, most likely have supported expansion of humpback chub and other native fishes into the western Grand Canyon. Though the conditions for razorback sucker are good, there have not been many adult razorback suckers detected above Pearce Ferry Rapid, and no larval razorback suckers have been detected since 2019 (Pennock et al. 2022). In 2022, one adult and 36 larval razorback suckers were captured in the Colorado River inflow to Lake Mead indicating there is some utilization of the inflow to Lake Mead by razorback suckers (Rogers et al. 2022).

As warmer water is released through Glen Canyon dam, habitat conditions may be more supportive of razorback suckers and other native fishes. Warmer water temperatures may create more suitable habitat for larvae and juveniles. However, these effects could be offset if nonnative fish increase.

Razorback suckers have been detected in the Colorado and San Juan River inflows to Lake Powell. In Lake Mead, despite changing water levels, razorback suckers have adapted and appear to be flexible in microhabitat use as evidenced by larval production remaining steady despite changes in reservoir elevation. Although the location of the inflows to Lake Powell shifts as the elevation of the reservoir changes, razorback suckers are expected to adapt and survive and recruit under a broad range of hydrologic and environmental conditions as they have in Lake Mead (Rogers et al. 2023), and as such, the action is not expected to affect razorback suckers in the inflows.

Colorado Pikeminnow

Legal Status and Recovery Goals

The Colorado pikeminnow was included in the 1967 List of Endangered Species (Federal Register 32:4001), and its status was later amended under the ESA. The *Colorado Squawfish Recovery Plan* was approved in 1991 (USFWS 1991) and was amended and supplemented with the 2002 *Colorado Pikeminnow (Ptychocheilus lucius) Recovery Goals* (USFWS 2002d). Critical habitat was designated for this species in 1994 in the Upper Basin (Federal Register 59:13374–

13400); however, there is no designated critical habitat for this species in the Lower Basin. The USFWS completed a 5-year review in 2020 (USFWS 2020b), in which it recommended the species continue to be classified as endangered. A species status assessment was completed in 2020 (USFWS 2020c) and revised in 2022 (USFWS 2022).

Two recovery programs, the Upper Colorado River Program and the San Juan River Program were established to balance water delivery consistent with species conservation (https://coloradoriverrecovery.org/). The San Juan River Basin Recovery Implementation Program was developed to help conserve the Colorado pikeminnow and the razorback sucker in the San Juan River Subbasin. The Upper Colorado River Recovery Program was established to help conserve the same two species, as well as the humpback chub and bonytail in the Green and Upper Colorado Subbasins.

Recovery goals for this species rely on specific target numbers of wild Colorado pikeminnow in each of the subbasins (USFWS 2002d). The San Juan population is maintained through stocking; populations have declined in the Green River and Colorado River since 2000 and 2005, respectively, but these two populations are not maintained by stocking (USFWS 2022).

Historical and Current Range

The Colorado pikeminnow historically occurred throughout the Colorado River Basin in various states (USFWS 2022). However, this species was extirpated from the Lower Colorado River Basin because of water development in the 1960s (USFWS 2022). Currently, the Colorado pikeminnow occurs only in the Upper Basin in the Green and Upper Colorado Rivers, including the San Juan River. The low levels of Lake Powell have resulted in the creation of approximately 30 miles (48 km) of additional riverine habitat, which has allowed for an expansion of the Colorado pikeminnow populations in the Colorado River and San Juan inflows to Lake Powell (Pennock, McKinstry, et al. 2020; Pennock, McKinstry, and Gido 2020). In the Colorado River, spawning occurs annually; however, recruitment to the adult population is low (USFWS 2022). In the San Juan River, spawning also occurs annually, but recruitment past age-1 is low and this population relies on stocking to persist (USFWS 2022).

Life History

The Colorado pikeminnow is the largest North American minnow in the family Cyprinidae, reaching over 5 feet long (USFWS 2022). This species is long-lived (40+ years) (Osmundson and Kaeding 1989) and often migrates long distances to and from spawning areas (Tyus and Karp 1990). Spawning is associated with temperature, and flow occurs during the summer from June (during dry, low-flow years) through August (cooler, higher-flow years) (Bestgen and Hill 2016). This species matures at 5 to 7 years old and is relatively fecund, broadcasting adhesive and demersal eggs over clean spawning substrate (gravel and cobble). Eggs hatch within 4 to 7 days, and recently hatched larvae remain in interstitial spaces of cobbles and gravels for another 4 to 8 days before emerging into the current (USFWS 2022). Larvae drift and eventually settle in low-velocity nursery habitat, where water temperatures are warm. Young Colorado pikeminnow feed on macroinvertebrates, and juveniles and older fish eventually switch to larger prey, such as fish.

Habitat

Spawning occurs over gravel and cobble that has been cleaned from runoff. Eggs reside in the interstitial spaces until hatching, where recently hatched larvae remain for up to 8 days post-hatch. Larvae then are transported to areas with low-velocity nursery habitats such as backwaters and embayments (Bestgen and Hill 2016). These nursery areas provide warm water temperatures and an abundance of food to support rapid growth. This species exhibits an ontogenetic shift toward deeper waters as it grows larger, likely to support its change in prey. Juveniles continue to use shallow shoreline habitats, including sandy backwaters, and begin to transition into mainstem habitats used by adults. These include large eddies, deep pools, and deep runs (USFWS 2002d).

Critical habitat

Designated critical habitat in the action area included in this BA occurs from the Colorado River inflow from full pool elevation of Lake Powell (3,700 feet) near Imperial Canyon downstream to the confluence of the Dirty Devil River (Federal Register 59:13374–13400).

Population within the Action Area

There are no Colorado pikeminnow between Glen Canyon Dam and Pearce Ferry Rapid (RM 280). However, Colorado pikeminnow occupy the inflows of the San Juan and Colorado Rivers to Lake Powell. The low elevation of Lake Powell over the last several years has changed the location of the inflows so that Colorado pikeminnow are now in the action area (Francis et al. 2017).

Southwestern Willow Flycatcher

Legal Status and Recovery Goals

The southwestern willow flycatcher is one of four currently recognized willow flycatcher subspecies (Browning 1993; Phillips 1948; Unitt 1987). On March 29, 1995, the southwestern willow flycatcher was listed as endangered (Federal Register 60:10694) across its entire range, which includes Arizona, California, Colorado, New Mexico, Texas, Utah, and Mexico.

The recovery plan and goals for the southwestern willow flycatcher were completed in 2002 (USFWS 2002e). The recovery plan established six recovery units that are further subdivided into management units. These recovery and management units are based on watershed and hydrologic units within the breeding range of the flycatcher (USFWS 2002e). Lake Powell is within the Upper Colorado Recovery Unit, which encompasses the San Juan River and Lake Powell. At the time the recovery plan was completed, this recovery unit contained three known territories (<1% of the rangewide total). The Grand Canyon is within the Lower Colorado Recovery Unit, which encompasses the Colorado River and its tributaries from Glen Canyon Dam downstream to the Mexico border. Despite the large size of this recovery unit, the unit contained only 146 known territories (15% of the rangewide total) at the time the recovery plan was completed (USFWS 2002e).

The recovery objective for the species is to attain a population size and distribution of habitat sufficient to maintain metapopulations over the long term. Threats to the species must be

addressed to achieve this goal. In general, the minimum number of territories needed and maintained over a 5-year period is 1,950 (approximately 3,900 individuals), distributed geographically to allow for functioning metapopulations. In addition, the total known population would need to be increased to 1,500 territories (3,000 individuals), distributed geographically among the management units and recovery units, so that the species is no longer in danger of extinction.

A 5-year status review for the southwestern willow flycatcher was completed by the USFWS in 2017 (USFWS 2017). It was determined that the status of the species had improved due to an increase in the number of known territories since it was listed in 1995; however, downlisting and delisting criteria related to the distribution and abundance of territories had not been met. Ongoing threats related to land and water management and the spread of tamarisk leaf beetle (*Diorhabda* spp.) and exotic shot hole borer beetle (*Euwallacea* spp.) remained concerns. Due to these ongoing threats, the USFWS determined that no change in status was warranted.

Historical and Current Range

The southwestern willow flycatcher is a neotropical migrant that breeds in the southwestern United States and migrates to Mexico, Central America, and possibly northern South America during the non-breeding season (Howell and Webb 1995; Peterson 1990; Phillips 1948; Ridgely and Tudor 1994; Stiles and Skutch 1989). The Pacific lowlands of Costa Rica appear to be a key winter location for the southwestern willow flycatcher, although other countries in Central America may also be important (Paxton et al. 2011). Historically, the range of the southwestern willow flycatcher in Arizona included portions of all major watersheds (USFWS 2002e); however, many of these watersheds have changed. As a result, most of the areas where southwestern willow flycatchers were locally abundant now support few or no individuals (USFWS 2002e). Habitat and population numbers of southwestern willow flycatchers have declined in recent decades due to several factors, including loss, degradation, and fragmentation of riparian habitat; invasion by nonnative plants; brood parasitism by brown-headed cowbirds; and loss of wintering habitat (Stroud-Settles et al. 2013).

Life History and Habitat

The southwestern willow flycatcher is a generalist insectivore and breeds in dense riparian habitats near saturated soils, slow-moving water, or surface water from sea level in California to approximately 8,500 feet in Arizona and southwestern Colorado (Sogge et al. 2010). Occupied sites often have an interior of dense vegetation intermingled with small openings, shorter vegetation, and open water (USFWS 2002e). The densest vegetation often occurs within the first 10 to 13 feet (3–4 m) above the ground. Occupied patches can be as small as 0.8 acre and as large as several hundred acres and are typically >33 feet (>10 m) wide (Sogge et al. 2010). Historical egg/nest collections and species descriptions throughout its range identify the southwestern willow flycatcher's widespread use of willow (*Salix spp*.) for nesting (Hubbard 1987; Phillips 1948; Phillips et al. 1964; San Diego Natural History Museum 1995; Unitt 1987). Nonnative tamarisk (*Tamarix* spp.) is also widely used for nesting, and Russian olive (*Elaeagnus angustifolia*) is used in certain locations. Throughout the southwestern willow flycatcher's current range, suitable riparian habitats tend to be small, linear patches separated by vast expanses of arid land.

The southwestern willow flycatcher arrives on the breeding grounds throughout May and early June, eggs are generally laid beginning in May, and fledging occurs between June and August (Sogge et al. 2010). The entire breeding cycle, from egg laying to fledging, is approximately 28 days.

Population within the Action Area

There is little information on the number of southwestern willow flycatchers along the river prior to construction of the Glen Canyon Dam. However, those data that are available suggest that southwestern willow flycatchers were not common breeders along the Colorado River in the Grand Canyon (Brown 1988a, 1988b, 1991; Sogge et al. 1997).

Disjunct breeding locations in the Grand Canyon have been documented below Lees Ferry in Marble Canyon and in lower Grand Canyon below Diamond Creek (RM 225.5–RM 277) (Braden and McKernan 2006; McLeod, Koronkiewicz, Brown, et al. 2008; Sogge et al. 1997). No southwestern willow flycatcher nests or nesting behavior have been identified in the inner gorge (RM 77.9–RM 116.5). Southwestern willow flycatcher territories in the Grand Canyon are generally located in the tamarisk-dominated riparian vegetation along the river corridor but not in the mesquite (*Prosopis* spp.)–acacia (*Acacia greggii*)- and hackberry (*Celtis reticulata*)-dominated habitats higher on the slopes (Sogge et al. 1997). The southwestern willow flycatcher's nesting habitat is dynamic in that it varies in occupancy, suitability, and location over time. Because river channels, river flows, and floodplains are varied and can change over time, the location and quality of nesting habitat may also change over time.

Studies conducted along the river from 1982 to 1991 between Lees Ferry and Phantom Ranch found a total of 47 adult southwestern willow flycatchers—14 pairs and 15 nests (Brown 1988a; Sogge et al. 1997). Surveys conducted between 1992 and 2004 indicated a small (one to four territories annually) resident breeding population between Lees Ferry and Cardenas Marsh (RM 71), but no territories were located from RM 71 through RM 246 (Haynes and Ward 2007; Paradzick et al. 2001; Sogge et al. 1997). From 1993 through 2003, breeding southwestern willow flycatchers were present during each year of surveys at RM 50.4 through RM 51.5 but were not present after 2003 (Slayton et al. 2009; Sogge et al. 1997). Another area of importance in the mid-1990s was Cardenas Marsh (RM 71–RM 71.5); however, occupancy has not been documented since 1994.

Beginning in 2005, annual surveys were conducted from Lees Ferry (RM 0) to Phantom Ranch (RM 88). From 2005 through 2009, four willow flycatchers (not confirmed as southwestern willow flycatchers) were detected between Lees Ferry and Phantom Ranch; all of these appeared to be migrants (Palarino et al. 2010; Stroud-Settles et al. 2013). In 2019 and 2021, surveys were conducted along the entire river including historical locations where southwestern willow flycatchers had been identified previously. Traditional upriver habitats such as Kwagunt Marsh (RM 56 right) and Cardenas Marsh (RM 71.1 left) are no longer marsh areas with the plant species desirable for southwestern willow flycatchers. Since 2004, surveys have only detected southwestern willow flycatcher pairs on the lower half of the Colorado River.

Presence/absence surveys and habitat assessment were completed from Lees Ferry to Diamond Creek from 2010 through 2012. Although five willow flycatcher detections were recorded in 2010, three in 2011, and none in 2012, none were confirmed as southwestern willow flycatchers

(Stroud-Settles et al. 2013). Surveys were completed in 2019 and 2021 from RM 0 through RM 280. No willow flycatchers were detected during surveys in 2019. In 2021, four willow flycatchers were detected in May between Lees Ferry and Diamond Creek, but no willow flycatchers were detected during subsequent surveys. The detected birds were likely spring migrants and were not confirmed to be southwestern willow flycatchers (Terwilliger and Holm 2021). In June 2023, two willow flycatchers were observed visually and audibly at 275-mile marsh (NPS 2023).

Factors Affecting Distribution and Abundance in the Grand Canyon

The southwestern willow flycatcher has experienced extensive loss and modification of habitat and is also endangered by other factors, including brood parasitism by the brown-headed cowbird (*Molothrus ater*). The southwestern willow flycatcher was federally listed primarily due to riparian habitat reduction, degradation, and elimination as a result of agricultural and urban development. Other reasons for the decline/vulnerability of the southwestern willow flycatcher include the fragmented distribution and low numbers of the current population, predation, and other events such as fires that are naturally occurring but have become more frequent and intense because of fuel buildup and the proliferation of exotic vegetation (USFWS 2017).

The Grand Canyon does not provide extensive stands of dense riparian habitat suited for breeding southwestern willow flycatchers. Most patches of riparian vegetation in the Grand Canyon lack a consistent, dependable source of water for maintaining moist/saturated soil conditions and/or slow-moving or standing surface water (Stroud-Settles et al. 2013). As a result, most habitat in the Grand Canyon that might be used by southwestern willow flycatchers is of marginal quality, and these patches are likely to continue to decline without an increase in surface water. Furthermore, the tamarisk leaf beetle has transformed and will continue to transform the patches of dense tamarisk into unpredictable, diminished patches (Stroud-Settles et al. 2013; Terwilliger and Holm 2021). Riparian vegetation in the only two sites (RM 259.5 [Burnt Springs] and RM 275) where breeding southwestern willow flycatchers have been detected since 2001 is maintained by water in tributary canyons or from springs and is not dependent on flow in the mainstem of the Colorado River.

Western Yellow-billed Cuckoo

Legal Status

On October 3, 2014, the western distinct population segment of the yellow-billed cuckoo was listed as threatened (Federal Register 79:59992) across its range, which includes Washington, Oregon, Idaho, Nevada, Utah, California, and Arizona; portions of Montana, Wyoming, and Colorado west of the Continental Divide, and portions of New Mexico and Texas west of the watershed divide between the Rio Grande and Pecos Rivers. Critical habitat was designated on April 21, 2021 (Federal Register 86:20798). No recovery plan for the western yellow-billed cuckoo has been issued.

Historical and Current Range

Historically, the western yellow-billed cuckoo was a fairly common breeding species throughout the river bottoms of the western United States and southern British Columbia (Gaines and

Laymon 1984). As a result of the loss of riparian woodland, the western yellow-billed cuckoo has become an uncommon to rare summer resident in scattered locations throughout much of its former range but no longer breeds in Washington, Oregon, or Montana (Federal Register 79:59993). The western yellow-billed cuckoo is a neotropical migrant and winters in South America.

Life History and Habitat

The western yellow-billed cuckoo nests in blocks of riparian woodland that are usually 50 acres or larger (Halterman et al. 2016; Federal Register 78:61622–61666). Reported home range sizes vary from 54 to 204 acres (McNeil et al. 2011; Federal Register 78:61622–61666). Occupied lowland riparian habitat generally consists of mature willow and cottonwood forest, although other riparian tree species such as mesquite and tamarisk may also be present. Breeding habitat generally has both overstory and understory components (Federal Register 78:61622–61666), and nest locations typically have high canopy closure (McNeil et al. 2013).

Western yellow-billed cuckoos are late spring migrants. Some individuals can arrive in mid- to late May, but most do not arrive until mid-June. Pair formation occurs from late June to mid-July (Halterman 1991). Nesting generally peaks during July and early August and can continue into September. Fall migration begins in August, and most birds have left by mid-September (McNeil et al. 2013). Large prey items such as cicadas, katydids, grasshoppers, and caterpillars form the bulk of the cuckoo's diet (Federal Register 78:61622–61666), and arrival on the breeding grounds may be timed to coincide with abundant prey. Population levels and breeding timing may be tied to the abundance of prey items (Halterman et al. 2016; Federal Register 78:61622–61666).

Population within the Action Area

Grand Canyon upstream of Separation Canyon does not support the large blocks of mature riparian forests used by western yellow-billed cuckoos as breeding habitat.

Western yellow-billed cuckoos were detected annually from 1996 through 1999 and in 2001 in the lower portion of Grand Canyon, between Spencer Creek (RM 246) and Pearce Ferry, during surveys for southwestern willow flycatchers (McKernan and Braden 2002). Evidence of breeding was documented in 1996 and 1997 but not in other years. No incidental detections of western yellow-billed cuckoos were recorded during southwestern willow flycatcher surveys between Separation Canyon (RM 239.5) and Pearce Ferry from 2004 through 2008, and no western yellow-billed cuckoos were detected during yellow-billed cuckoo broadcast surveys in 2004 at Burnt Springs and Spencer Creek (Koronkiewicz et al. 2006; McLeod and Koronkiewicz 2009; McLeod et al. 2005, 2007; McLeod, Koronkiewicz, Nichols, et al. 2008). No cuckoos were detected during western yellow-billed cuckoo broadcast surveys at Spencer Creek or RM 275 in 2006 or at RM 275 in 2007 (Johnson et al. 2007; M. Johnson et al. 2008). Spencer Creek was not surveyed in 2007 because no habitat suitable for cuckoos was present (M. Johnson et al. 2008). An incidental detection of a western yellow-billed cuckoo was recorded at Burnt Springs during southwestern willow flycatcher surveys in 2021 (Terwilliger and Holm 2021).

Factors Affecting Distribution and Abundance in the Grand Canyon

The western yellow-billed cuckoo has experienced extensive loss and modification of habitat and was federally listed primarily due to riparian habitat reduction, degradation, and elimination. Other reasons for the decline/vulnerability of the western yellow-billed cuckoo include the fragmented distribution of the current population, exposure to pesticides on both the breeding and wintering grounds, and collisions with tall structures during migration (Federal Register 78:61622–61666).

Most of the Grand Canyon cannot support the extensive stands of mature, riparian habitat suited for breeding western yellow-billed cuckoos because riparian vegetation is limited to a very narrow band along the margins of the Colorado River mainstem and in narrow side canyons. Habitats used by western yellow-billed cuckoos were present along the mainstem of the river in lower Grand Canyon in the mid- and late 1990s and early 2000s when high levels of Lake Mead supported cottonwood-willow vegetation. Declining water levels in Lake Mead in the early 2000s left riparian vegetation along the mainstem between Separation Canyon and Pearce Ferry on high, dry riverbanks, where the vegetation subsequently died (McLeod, Koronkiewicz, Brown, et al. 2008). After the early 2000s, the only stands of mature, riparian habitat in the action area were in side canyons such as Burnt Springs and at the spring-fed RM 275 site and were not dependent on flow in the mainstem of the Colorado River.

Effects Analysis of Proposed Action

Based on the June 2023 Colorado River Mid-term Modeling System (CRMMS) 24-month study, the minimum probable inflow scenario predicted Lake Powell's elevation to be 3,548 feet in April 2024. The elevation of the lake compared to the penstock elevation and the volume of inflow from tributaries above Glen Canyon Dam affects the release temperature. When the warmer surface water (epilimnion) more closely aligns with the penstocks (3,490 feet), the risk of entrainment increases as well as the temperature of the water released through the dam.

Similar elevations are expected to be observed for the proposed action compared to the no action alternative (Figure 4). In 2024, no modeled traces fall below a Lake Powell elevation of 3,490 feet under either the no action alternative or the proposed action. In 2025, 1.5% of the no action alternative traces fall below an elevation of 3,490 feet at some point during the operating year while none of proposed action traces do. In 2026, the no action alternative results in 6% of traces falling below 3,490 feet, while 2% of the proposed action's traces do so. Because Reclamation is preparing a new EIS to address guidelines after 2026, the effects in this BA are only considered through 2026.

The modeling assumptions do not include DROA actions, which if implemented could further reduce the likelihood of a 6.0 maf release. Reclamation is also preparing a SEIS to the LTEMP to analyze flow options to prevent additional spawning of smallmouth bass. If these flows are implemented, they are designed to benefit native fishes by reducing spawning success of smallmouth bass meaning effects on threatened and endangered fishes would be lower than analyzed here. In other words, there is a very small possibility of poor hydrology in 2026 which could lead to implementation of the proposed action becoming necessary if no other actions are taken.

The proposed action and the no action alternatives are very similar. There are only a few traces where there is a difference between the proposed action and no action which primarily occurs in the driest of hydrologic traces (see Figure 4). This difference occurs because the proposed action includes actions which results in elevations near 3,500 feet for longer where entrainment risk is higher and water release temperature is higher. In comparison, the no action switches over to releasing water from the river outlets where entrainment risk is very low, and the water release temperature is much colder.

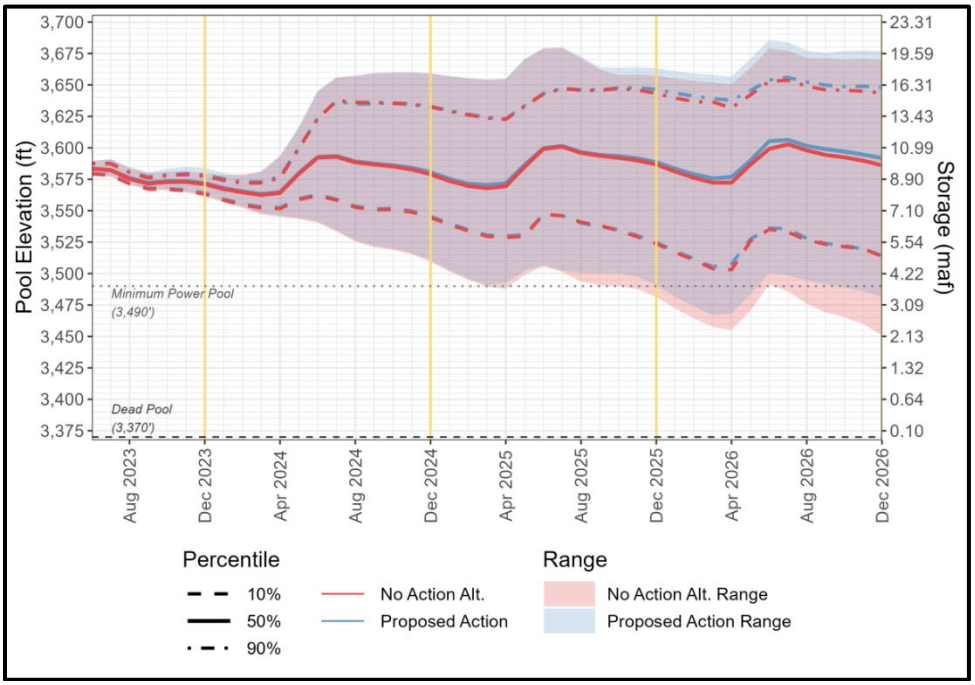


Figure 4. The full range of modeled Lake Powell elevations for the proposed action and no action alternatives through 2026 (Figure 3-5 in SEIS).

Humpback Chub

Evaluation of the potential impacts of the proposed action to humpback chub is based on the eight criteria as listed in the species status assessment (USFWS 2020a).

1. Diverse rocky canyon river habitat

The proposed action would have the potential to include release volumes lower than those currently described in the LTEMP EIS (DOI 2016). Specifically, release volumes as low as 6.0 maf could occur (see Table 1). The major reproducing population of humpback chub is in the Little Colorado River, which would be unaffected by releases from the dam. However, it is possible that reduced flows could impact habitat availability for humpback chub in the Colorado River through the Grand Canyon if the amount of backwater/low-velocity habitat is reduced for young fish. Backwaters can have warmer water than other habitats, and native fish, including humpback chub, are frequently observed in backwaters, leading to a common perception that this habitat is critical for juvenile native fish conservation. However, backwaters are rare and ephemeral habitats, so they contain only a small portion of the overall population. Dodrill et al. (2015) showed the total abundance of juvenile humpback chub was much higher in talus than in

backwater habitats, which could be a factor of availability of talus habitats versus backwaters. The Near Shore Ecology project concluded that backwaters are likely not important to the Little Colorado River chub aggregation because they are not a significant habitat component in that area (Pine et al. 2011).

Young humpback chub remain along shallow shoreline habitats throughout their first summer, at low water velocities and depths less than 3.3 feet (Valdez and Ryel 1995, 1997). They shift as they grow larger and, by fall and winter, into deeper habitat with higher water velocities and depths up to 4.9 feet. Effects are not expected for adults because they are not as dependent on these slow-moving habitats, which are affected by flow-related changes.

The population of humpback chub that has become established in the Colorado River inflow to Lake Mead (Separation Canyon to Pearce Ferry Rapid) over the last few years (Van Haverbeke et al. 2017) may be positively affected by reduced flows from Glen Canyon Dam operations due to expansion of additional river habitat; those effects were also evaluated under the 2005 LCR MSCP BO (USFWS 2005). This population of humpback chub in the western Grand Canyon (Havasu Creek to Pearce Ferry Rapid) developed in the presence of flow actions and is unlikely to be affected by the proposed action because the downstream effects of the lower release volumes are minimized with downstream movement due to wave attenuation dynamics. In addition, lower release volumes would mean warmer water temperatures which would lead to faster growth. However, the western Grand Canyon population of humpback chub and more specifically humpback chub in the inflow area are very susceptible to predation by nonnative fish from Lake Mead. Although the proposed action will not cause Lake Mead elevation to increase to a level where Pearce Ferry Rapid no longer serves as a barrier, if natural riverine processes or other non-dam–related actions were to cause Pearce Ferry Rapid to degrade or to allow more frequent passage of nonnative fishes, humpback chub would be negatively affected.

The proposed action could reduce the amount of backwater habitat available for young humpback chub in the Colorado River mainstem, but the most important habitat is in the Little Colorado River which would not be affected by the action. The proposed action would create more river habitat in the Grand Canyon and warmer temperatures which result in faster growth. Because the proposed action could decrease the amount of backwater habitat but could also create more riverine habitat and increase growth, the proposed action may affect the diverse rocky canyon habitat but is unlikely to adversely affect it.

2a. Suitable flow

The proposed action includes a similar release pattern to that listed in LTEMP, which regulates the fluctuations in flows. Fluctuating flows within the ranges observed in LTEMP do not have significant impacts on humpback chub (Dzul et al. 2016). Because the proposed action is within the limits described within LTEMP, no additional effects are expected to result from the proposed action.

2b. Suitable temperature

When the elevation of Lake Powell is closer to full pool (3,700 feet) release temperatures are cool and hardly vary due to the position of the penstocks deep in the reservoir in relation to the warmer surface waters. As the elevation of Lake Powell approaches 3,500 feet, the thermal

regime will become more variable, including slightly colder winter release temperatures and much warmer summer release temperatures. Release temperatures are the main factor affecting water temperature near the dam, however, as water travels farther away from the dam, other factors including seasonal variation in solar insolation contribute to summer warming and winter cooling of water temperatures (Dibble et al. 2021; Mihalevich et al. 2020). The water temperatures that are expected for the proposed action and no action alternatives are very similar (Figure 5). The optimum temperature for humpback chub growth and spawning is 16°C to 22°C and warming in recent years has likely benefitted humpback chub. Increased river temperatures are likely to increase growth rates of humpback chub (Dzul et al. 2016; Yackulic et al. 2018), which is beneficial to younger life stages because the fish grow more quickly to a size where they can evade predation (Yard et al. 2011).

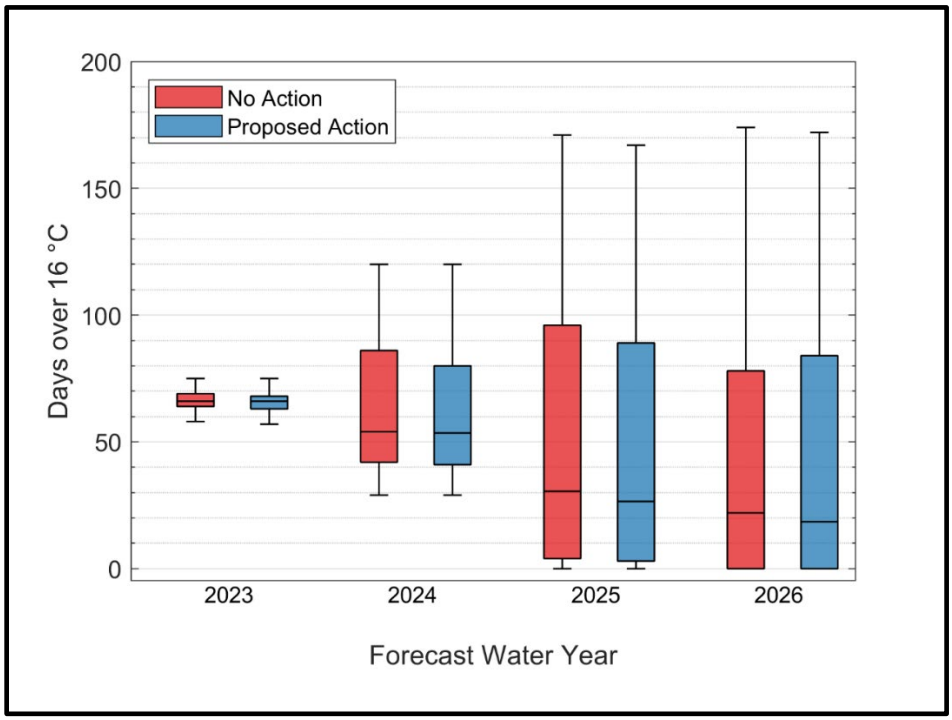


Figure 5. Boxplots showing the number of days with an average Glen Canyon Dam release temperature over 16°C for 60 traces for the proposed action and no action alternatives for 2023-2026. The dark line represents the median, the boxes represent the upper and lower 25% quantiles, and the whiskers extend to the most extreme data points not considered outliers.

Humpback chub are a warmwater fish and the temperatures that are predicted for the proposed action are within the optimal range for growth and spawning. The temperatures for the proposed action and no action alternatives are so similar that there is no effect predicted for temperature due to the action. Because warmer temperatures are beneficial for humpback chub and the temperature is so similar for the proposed action and no action alternatives, any action is expected to have a positive effect on suitable temperature for humpback chub.

3. Adequate and reliable food supply

If monthly releases are similar to those currently observed, overall food base production and diversity is expected to be similar to what it has been for the past several years (Cross et al. 2013; Hall et al. 2015; Kennedy et al. 2014). Lower monthly releases would be expected to increase food base production for two reasons: 1) with lower volumes, the range in daily fluctuations in stage would decrease, which would be expected to increase survival of sensitive insect eggs and increase overall insect abundance; and 2), and food base production tends to accelerate when flows are low. Water temperature can also affect food base production, but the proposed action is likely to have a positive effect on food base production because the temperatures are expected to be warmer than 12°C. The proposed action is expected to have a positive effect on the food supply because food base production and diversity is expected to be similar or better compared to previous years due to the potential for warmer temperatures and lower range in daily fluctuations in stage.

4. Habitat with few nonnative predators and competitors

Although rainbow and brown trout are potential predators of the humpback chub, temperatures above 20°C are expected to decrease the swimming ability of cold-water sight predators, such as rainbow trout (Yard et al. 2011). Rainbow trout and brown trout may also struggle to grow and maintain suitable body condition (Korman et al. 2023). Also, most brown trout and rainbow trout are found in the Glen Canyon Reach where there are no humpback chub.

While warmer temperatures are beneficial for native species, warmer temperatures also benefit warmwater nonnative fish (Dibble et al. 2021). If certain warmwater invasive fish species such as smallmouth bass establish in the Grand Canyon, the humpback chub population could be negatively affected (B. Johnson et al. 2008). The proposed action and the no action alternatives result in very similar temperatures which exceed 16°C for a significant portion of the year, particularly for 2025 and 2026 (see Figure 5).

Smallmouth bass were rarely observed in the Colorado River ecosystem below Glen Canyon Dam prior to 2022 (22 individuals total over two decades – Grand Canyon Monitoring and Research Center [GCMRC] database); however, reproduction was identified for the first time in summer 2022 (NPS 2022b). Historically low reservoir elevations in Lake Powell have contributed to dramatic warming of water release temperatures, making the river more suitable for reproduction of smallmouth bass and other warmwater invasives (Dibble et al. 2021); lower reservoir elevations also increase the risk of entrainment of smallmouth bass through Glen Canyon Dam.

Due to historically high snowpack in 2023, the elevation as of July 2023 is at a level (3,584 feet) where the risk of entrainment is low. However, due to the negative impact that smallmouth bass have had on native fishes in the Upper Colorado River Basin, and the risk to humpback chub in the Grand Canyon if smallmouth bass become established (B. Johnson et al. 2008), smallmouth bass were examined in more detail. An entrainment model and population growth model were used to simulate the probability of entrainment under the 90 hydrologic traces for the proposed action (Eppehimer and Yackulic 2023). On average, smallmouth bass entrainment is expected to occur with approximately the same frequency for the proposed action as the no action alternative (Figure 6). The elevation of Lake Powell relative to the penstocks is important because once the

surface waters are approximately 50 feet higher than the penstocks, the risk of entrainment is low. Based on the June 2023 CRMMS 24-month study, the minimum probable inflow scenario predicts a Lake Powell elevation of 3,548 feet in April 2024, which is 58 feet above the penstock centerline where entrainment risk is low. However, the elevation of Lake Powell in 2026 is expected to decrease, and consequently the number of propagules is expected to increase (see Figure 6). In 2026, the number of propagules is higher for two of the traces for the proposed action because the elevation is close to 3,500 feet where entrainment is higher compared to the no action when the elevation drops below minimum power pool and entrainment becomes very low (Figure 6).

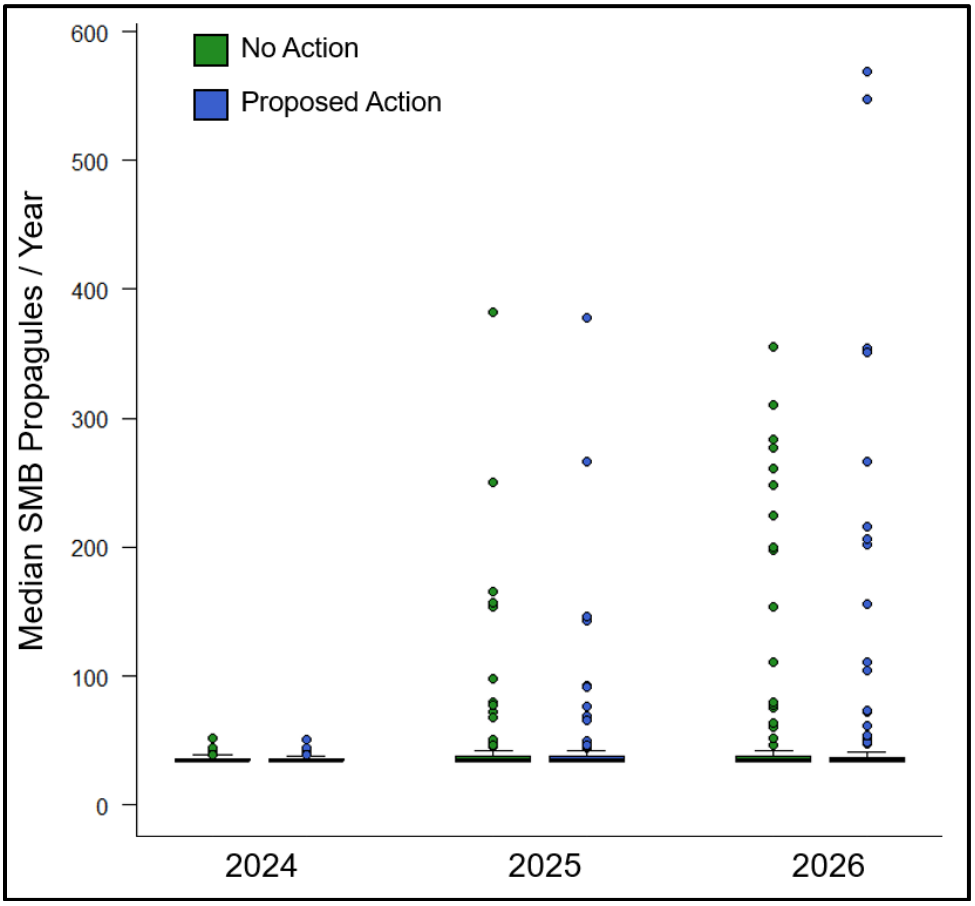


Figure 6. Forecasts of the median number of smallmouth bass entrained per year under the no action (green) and proposed action 3 (blue) alternatives. For each of the 90 hydrologic traces, the median forecasted entrainment was calculated, and the results were summarized using a box and whisker plot in which the dark line represents the median, the boxes represent the upper and lower 25% quantiles, and the whiskers extended to twice the interquartile range with dots representing traces with more extreme values.

Based on a recent study, there are more nonnative species in the forebay during summer months than in fall or spring (Friesen et al. 2023), suggesting this is when the risk of nonnative fish passage is highest. If smallmouth bass are present in Lees Ferry and the Little Colorado River reach, the proposed action and the no action alternative are expected to result in similar increases in the number of smallmouth bass in both locations (Figure 7). Note that smallmouth bass have

not been captured at the Little Colorado River confluence reach in recent years, however increasing populations in Lees Ferry may serve as a source of dispersing smallmouth bass.

Rapid response efforts are currently underway in an attempt to prevent establishment of smallmouth bass. In addition, Reclamation is pursuing a SEIS to LTEMP to evaluate flow options for addressing smallmouth bass which, if implemented, may reverse recent population increases of smallmouth bass.

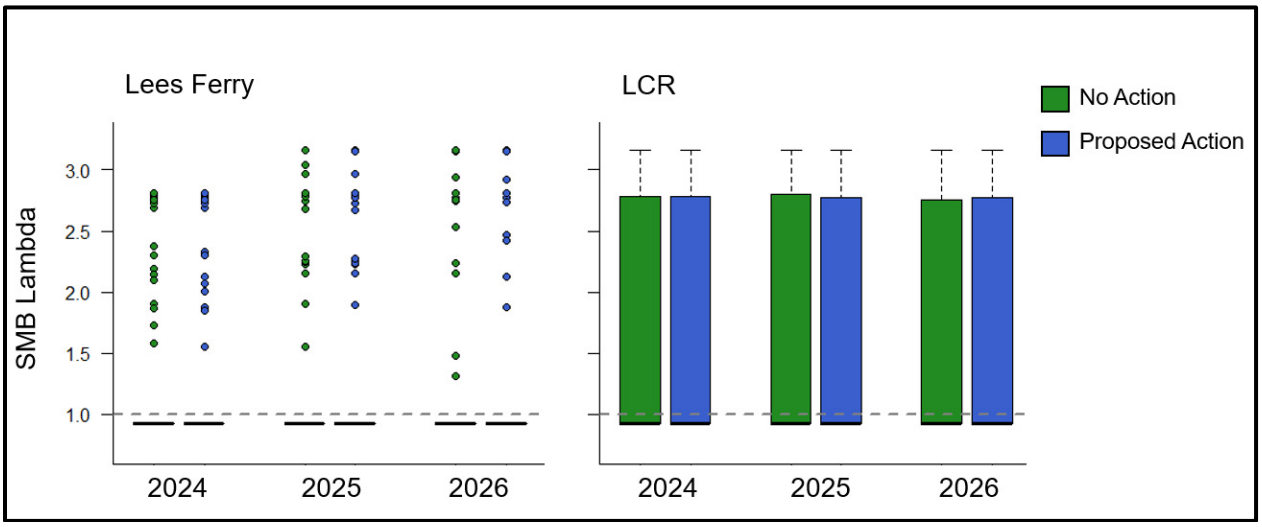


Figure 7. Forecasts of the potential annual smallmouth bass population growth rate (lambda) in Lees Ferry and the Little Colorado River confluence reaches of the Colorado River under no action (green) and proposed action (blue) scenarios. Lambda >1 indicates population growth. For each of the 90 hydrologic traces, the population growth rate was estimated based on forecasted daily water temperature and the results were summarized using a box and whisker plot in which the dark line represents the median, the boxes represent the upper and lower 25% quantiles, and the whiskers extended to twice the interquartile range with dots representing traces with more extreme values.

Pearce Ferry Rapid is currently serving as a partial barrier to upstream movement of nonnative fishes. If the water levels in Lake Mead were to rise enough to reduce the effectiveness of the barrier (approximately 1,116 feet) (Bruckerhoff et al. 2022), it is likely that the nonnative fishes that are known to occur below the rapid (Hedden et al. 2022) would move into the Grand Canyon and prey on humpback chub and other fish. However, a significant increase in the elevation of Lake Mead is not expected either due to the proposed action or based on predicted hydrologic conditions. If Pearce Ferry Rapid became more passable due to effects unrelated to the action, humpback chub in the Grand Canyon would likely be negatively impacted.

Reduced flows can also lead to increased visibility and reduced levels of turbidity, except during and shortly after monsoonal rainstorms. Humpback chub use turbidity as cover from sight predators, and if the reduced flows result in more clear water, humpback chub could be more susceptible to predation. However, turbidity is also affected by inputs from the tributaries. High monsoonal or spring runoff could affect turbidity levels in the river in different reaches. High levels of turbidity would likely reduce the effectiveness of smallmouth bass predation on humpback chub (Edwards et al. 1983; Ward et al. 2019).

The temperatures associated with the proposed action and no action alternatives are predicted to be very similar. Warmer water that is beneficial for humpback chub is also beneficial for nonnative warmwater fish. Because there is a potential for warmwater nonnative species such as smallmouth bass to establish, the proposed action and the no action alternatives could result in an increase in the number of competitors and predators which would have a negative effect for humpback chub. Furthermore, if entrainment of these fish increases, combined with the warmer water temperatures, an increased observance of parasites would be expected (Choudhury et al. 2004; Hoffnagle et al. 2006).

5. Suitable water quality

Dissolved oxygen concentrations below 5.2 milligrams per liter (mg/L) often have growth and reproductive effects for cold water fish and concentrations below 3.8 mg/L are estimated to cause ≥ 50% growth impairment and to mark the onset of fish mortality events in rainbow trout (Korman et al. 2017). Dissolved oxygen levels in the Glen Canyon Reach may decrease due to increased deltaic sediment resuspension in Lake Powell and associated dissolved oxygen demand in the reservoir water column (Wildman and Hering 2011). Modeling suggests that low dissolved oxygen events (<5 mg/L) would be very slightly more probable under the proposed action (80% of years) than under the no action alternative (78% of years). However, this would not impact humpback chub since the water is oxygenated by the time it reaches Badger Rapid (RM 8), and humpback chub are not found above Badger Rapid.

Other water quality components such as contaminants are not expected to be any higher for the proposed action compared to the no action alternatives because they are so similar. Turbidity could be reduced with less water released which could lead to increased predation on native fishes such as humpback chub which use turbidity for cover.

Although other water quality effects on humpback chub are expected to be limited, reduced turbidity would be expected when less water is released which would be negative for humpback chub because they use turbidity to avoid predation.

6. Unimpeded range and connectivity

The river will still flow with the proposed action and will not disconnect the perennial tributaries (Little Colorado River, Bright Angel, Havasu, etc.) from the mainstem. The proposed action is not expected to affect humpback chub range and connectivity because it will not affect the connectivity of the tributaries with the Colorado River mainstem.

7. Persistent populations

Water temperature is expected to be relatively similar for the proposed action and the no action alternatives with temperatures above 16°C expected in 2024–2026 (see Figure 5). Humpback chub grow faster when temperatures are warmer at the Little Colorado River, but downstream river temperatures are less impacted by dam release and more affected by solar warming.

Other factors besides water temperature such as competition and predation can limit humpback chub growth at warmer temperatures. If a nonnative warmwater fish such as smallmouth bass established over the next few years, an indirect negative impact would likely occur to humpback chub in the period directly following the time frame covered by the proposed action (beginning

in 2027). Smallmouth bass invasion into rivers throughout the globe have been associated with substantial population declines, and in many instances, extirpations of native fish species (Brown et al. 2009; Loppnow et al. 2013). In the Upper Colorado River Basin, smallmouth bass are considered the greatest threat to the persistence of threatened and endangered fish species (B. Johnson et al. 2008). Smallmouth bass are fecund, adaptable to a substantial range of environmental conditions, and extremely capable predators (Edwards et al. 1983; B. Johnson et al. 2008; Ward and Vaage 2019). These traits have allowed smallmouth bass to quickly increase in abundance and exert population-level impacts to species that did not co-evolve with them.

Smallmouth bass were first observed reproducing below the dam in summer 2022. Rapid response efforts are underway in an attempt to prevent establishment of smallmouth bass. The elevation of Lake Powell as of July 2023 is currently high enough (3,584 feet) where additional entrainment of smallmouth bass or other species is considered low risk.

There are a large number of humpback chub in the Colorado River mainstem including the western Grand Canyon as well tributary populations in the Little Colorado River, Bright Angel Creek and Havasu Creek. Because the proposed action will not affect humpback chub in the tributaries and the action would only be implemented (if at all) for a short time and the tributaries will still be connected to the mainstem and can still move, the proposed action is not expected to affect persistent populations.

8. High genetic diversity

The effect on genetic diversity would be highly uncertain, but the proposed action is not expected to have any effect. There is a small possibility that the action will be implemented in 2026 which is too short of a time frame to effect genetic diversity. Even if the proposed action is implemented, it is not expected to affect the diversity of humpback chub within the Grand Canyon because the current abundance of humpback chub is high. Also, the proposed action and the no action alternatives are so similar an effect on genetic diversity is unlikely (Figure 8). Because the proposed action would only be implemented for a short period of time in 2026 if necessary and because humpback chub can move to other tributaries that are not affected by the action, the proposed action is not expected to have an effect on genetic diversity.

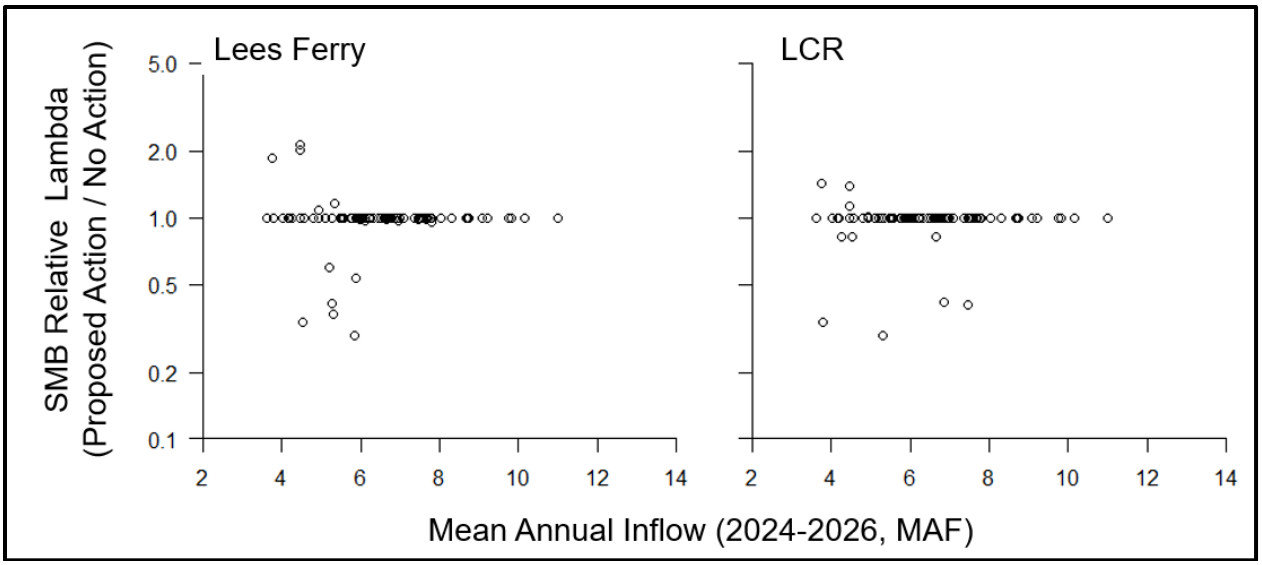


Figure 8. Difference in forecasted potential annual smallmouth bass population growth rate (lambda) in Lees Ferry and the Little Colorado River confluence reaches of the Colorado River under the proposed action and no action alternatives. For each of the 90 hydrologic traces, the ratio of the expected (2024-2026) population growth rates from 2024-2026 was calculated and plotted versus the mean annual inflow from those years.

Determination

Because the proposed action could have an effect on the diverse rocky canyon habitat, could reduce turbidity, and could affect the number of predators and competitors in the habitat, Reclamation has determined that the proposed action may affect and is likely to adversely affect humpback chub under certain hydrologic scenarios.

Humpback Chub Critical Habitat

Critical habitat for humpback chub in the action area includes the Colorado River and its 100-year floodplain downstream of Glen Canyon Dam from Nautiloid Canyon (RM 35) to Granite Park (RM 209). Although there is critical habitat in the Little Colorado River, it extends from RM 8 (13 km) down to the confluence of the Colorado River. Water quantity and quality and associated fish habitat in the Little Colorado River are affected primarily by perennial springs in the lower sections and seasonally by runoff from tributaries in the upper sections. The areas typically used for spawning are likely too far from the confluence to be affected by changes to the Colorado River. The proposed action is not expected to affect critical habitat in the Little Colorado River and as such is not discussed further. There is no critical habitat for the humpback chub within the full pool elevation of either Lake Powell or Lake Mead.

The primary constituent elements (PCEs) described in the final rule were water, physical habitat, and the biological environment (59 Federal Register 13374). On February 11, 2016, the USFWS published a final rule implementing changes to the regulations for designating critical habitat (Federal Register 81 7414). The changes included a regulatory definition for the ESA's phrase "physical or biological features" and elimination of the phrase "primary constituent element". The designation of critical habitat for humpback chub uses the term primary constituent element.

The new critical habitat regulations (Code of Federal Regulations [CFR] 402.01 and 402.12) eliminated that term and uses the ESA's phrase physical or biological features (PBF). The change does not alter the approach used in conducting a "destruction or adverse modification" analysis. In this consultation document, we use the term PBF to represent the PCEs identified in the final rule for this designated critical habitat.

Water

Based on the species status assessment, water of sufficient quantity and quality should be delivered to a specific location in accordance with a hydrologic regime that is required for the particular life stage of each species.

The water quality and quantity has been modified by Glen Canyon Dam by altering water temperatures and flow regimes. However, since 1996, water releases from Glen Canyon Dam have been adaptively managed to improve water quality and quantity for humpback chub in the Colorado River through Grand Canyon (Reclamation 1995). These modified flows reduced daily fluctuations in river flow from peak power plant releases and allowed for higher spring releases to restore some aspects of the natural hydrograph. These flow actions appear to be assisting with maintenance of this PCE, with the caveat that the requirements necessary for all life stages of humpback chub in the mainstem to support a recovered Grand Canyon population are still under investigation (USFWS 2018b). With the proposed action, there is a potential for less water to be released. This could have a small effect on humpback chub that spawn in the mainstem and potentially reduce the amount of habitat for any larval fish in the mainstem. Minimal dissolved oxygen effects are expected because the water is oxygenated by the time it reaches Badger Rapid (RM 8) and humpback chub habitat is below Badger and other rapids.

Because the proposed action includes delivery of water of sufficient quantity and quality to the sections of the river where humpback chub are located, the proposed action is not anticipated to have additional affects to water beyond those described in LTEMP.

Physical habitat

The physical habitat includes areas for use in spawning, nursery, feeding, and movement corridors between these areas. This includes areas of the Colorado River system that are inhabited by fish or potentially habitable for use. In addition to river channels, these areas include bottomlands, side channels, secondary channels, oxbows, backwaters, and other areas in the 100-year floodplain, which when inundated provide spawning, nursery, feeding, and rearing habitats, or access to these habitats.

The population in Grand Canyon consists of a core population in and near the Little Colorado River and fish in the mainstem, including six aggregations located 41 to 90 km apart. The aggregations are connected by movements of fish between existing aggregations (USFWS 2018b). Evidence of successful recruitment and population expansion into the western Grand Canyon was documented in 2017 (Van Haverbeke et al. 2017). In 2022, this western Grand Canyon population was estimated at 40,000 to 60,000 adults between Havasu Creek and Pearce Ferry Rapid (USGS 2023a). Translocations of humpback chub have occurred into Bright Angel, Shinumo and Havasu Creeks in an attempt to achieve population redundancy through establishment of a spawning population. Humpback chub were translocated into Shinumo Creek (beginning in 2009, suspended in 2014 after a fire and subsequent floods) and Havasu Creek (beginning in 2011, last occurred in 2016); translocations were initiated to Bright Angel Creek in

2018 (Omana-Smith et al. 2022). Successful reproduction has been documented in the translocated population in Havasu Creek and abundance was estimated as 145 (95% confidence interval 138-170) in 2022 (Omana-Smith et al. 2022).

Nursery habitat for juvenile humpback chub may be limited by fluctuating flows that alternately flood and dewater mainstem near shore habitats important to early life stages of humpback chub and by the loss of sediment-formed habitats. The proposed action could result in less water released (no lower than 6.0 maf) than is currently released under LTEMP, but the release pattern would be similar (see Table 1). Feeding areas are available to all life stages, especially for adult fish as indicated by condition factor of adult fish in the mainstem compared to those in the Little Colorado River (Hoffnagle et al. 2006), although feeding areas in the mainstem may be limiting for juvenile humpback chub due to fluctuations on nearshore habitats (Converse et al. 1998).

The proposed action is expected to have minimal impacts on the physical habitat because it would not affect the connection between the Colorado river mainstem and the tributaries, the flow pattern would follow that described in LTEMP, and it only occur in 2026 if no other actions (such as DROA) are taken.

Biological environment

The biological environment includes food supply, predation, and competition. Food supply is a function of nutrient supply, productivity, and availability and other factors and can affect growth of each life stage of the species. Predation and competition, although considered a normal component of this environment, are out of balance due to introduced fish species in some areas.

Food supply determines the availability of food to support each life stage of humpback chub. Food supply is a function of many factors including algae production, nutrient concentrations, discharge regimes, turbidity levels, substrate quality, tributary flooding, and the diversity and species composition of invertebrate assemblages (Behn and Baxter 2017; Cross et al. 2013; Scholl et al. 2023; Stevens et al. 1997). River regulation decreases turbidity throughout the Colorado River, and these increases in water clarity are most pronounced in the tailwaters immediately downstream of the dam. Low turbidity in the tailwater permits increased algae growth on bottom substrates (Angradi 1994; Shannon et al. 1994) and supports extremely high invertebrate biomass in the tailwater reach of Glen Canyon Dam (Blinn et al. 1992; Cross et al. 2011; Stevens et al. 1997). However, nonnative New Zealand mudsnails dominate invertebrate biomass in Glen Canyon, and rainbow trout are unable to digest them (Vinson and Baker 2008), which creates a trophic dead-end—i.e., a large proportion of invertebrate biomass does not contribute to fish growth or production. Algae biomass and production decrease downstream as water clarity decreases (Carothers and Brown 1991; Hall et al. 2015; Stevens et al. 1997). This drives a downstream decrease in aquatic invertebrate biomass (Carothers and Brown 1991; Cross et al. 2013; Stevens et al. 1997). Unnatural water temperature regimes and highly altered flow regimes that include daily fluctuations in discharge associated with hydropower production likely also contribute to the low diversity and abundance of aquatic insects downstream of the Paria River (Carlisle et al. 2013; Kennedy et al. 2016; Stevens et al. 1997).

Nonnative fish species that prey on and compete with humpback chub affect the PBFs of the biological environment aspect of critical habitat. Catfish (channel catfish and black bullhead), trout (rainbow and brown trout), and common carp are well established in the action area and will continue to function as predators and competitors of humpback chub. Minckley (1991)

hypothesized that nonnative fish predation and competition may be the single most important threat to native fishes in Grand Canyon, and subsequent field studies and modeling have supported this hypothesis to varying degrees (Coggins et al. 2011; Marsh and Douglas 1997; Valdez and Ryel 1995; Yackulic et al. 2018; Yard et al. 2011). In 2015 and 2016, green sunfish established in a slough in the Lee's Ferry reach of Glen Canyon and brown trout are increasing in this reach as well. Partner agencies (AZGFD, USFWS, NPS, Reclamation, and USGS) treated the slough with piscicides in 2015 and 2016 to remove the green sunfish, but these treatments were not completely effective and green sunfish continue to inhabit the slough. NPS treated the slough with piscicides again in 2022 and 2023 to respond to the recent invasion of smallmouth bass. It is likely that invasions of nonnative, predatory fish will continue owing to highly altered river flow regimes (Olden et al. 2006).

Due to an increase in water temperature over the last few years, warmwater nonnative species that had previously only been detected sporadically were detected in large numbers in 2022 including evidence of successful reproduction, thus increasing the concern. Conditions in winter 2023 changed due to a record-breaking snow year that led to a large increase in Lake Powell reservoir elevations and concomitant cooling of water temperatures released from the dam. Although the water released from Glen Canyon Dam is colder than in 2022, it has still exceeded 16°C, and evidence of reproduction by smallmouth bass and other warmwater nonnative fishes has been observed in 2023.

The proposed action and no action alternatives include warmer temperatures that could lead to establishment of warmwater invasive species such as smallmouth bass which could negatively affect humpback chub because predation and competition would be expected to increase.

Determination

There is a potential for an increase in warmwater nonnative species that could compete with humpback chub for resources and prey on early life stages. Although the proposed action could affect the biological environment (specifically related to increased competition and predation if a warmwater nonnative fish becomes established), Reclamation has determined that these effects do not rise to the level of adverse modification of designated critical habitat for humpback chub. The remaining PBF parameters will not be adversely affected.

Razorback Sucker

The evaluation of potential impacts of the proposed action to razorback sucker was based on the eight resource categories identified in the species status assessment (USFWS 2018b) as included below.

1. Complex lotic and/or lentic habitat available to razorback sucker

The amount of backwater/low-velocity habitat could be reduced for young fish if they are in the Grand Canyon and the proposed action is implemented. No larval fish have been detected in the Grand Canyon since 2019 and no small-bodied razorback suckers have ever been detected in the Grand Canyon despite monthly surveys from March through September since 2014. Backwaters are rare and ephemeral habitats, and while important even in areas with large numbers of fishes, contain only a small portion of the overall population. A low detection of razorback suckers

indicates that, although the proposed action could result in a reduced number of individuals, it is unlikely to have a population-level effect. Also, the proposed action and the no action alternatives are so similar to each other that there is unlikely to be an effect due to the action.

Due to extreme drought conditions and low reservoir levels, water released through Glen Canyon Dam is much warmer than it was historically because the warmer surface waters more closely align with the turbines of the dam whereas previously, the warmer surface water was much higher resulting in the release of much colder water. Warmwater nonnative fishes have been detected sporadically below the dam since its completion, but summer 2022 was the first time that evidence of smallmouth bass reproduction was detected. Though smallmouth bass are a concern because they are a very efficient predator, they have not been detected below the Paria River, meaning that there is currently no overlap with potential habitat where razorback suckers have been identified.

In Lake Powell, the low elevation has resulted in the creation of additional riverine habitat for razorback suckers in the San Juan and Colorado River inflows to Lake Powell. Though the reservoir reached a record low elevation of 3,519 feet in March 2023, the proposed action is triggered based on an elevation of 3,500 feet. Additional habitat in the inflows would be created if the elevation of Lake Powell decreases (USFWS 2023a); however, it would be insufficient to have a population-level effect on razorback suckers because the populations in the inflows are likely extensions of the Green, Colorado, and San Juan Rivers (USFWS 2023b).

Lake Mead is the only place where natural recruitment is occurring although the population is still relatively small (<1,000) (Pennock et al. 2023). The proposed action is not expected to result in significant changes to water quality in Lake Mead because of the distance between Glen Canyon Dam and the lake. The razorback sucker population in Lake Mead has been self-sustaining despite changes in flow, and the proposed action would not change the type or amount of habitat available.

Warm water is associated with increased growth rates in razorback suckers. However, the warmer water could also result in an increase or establishment of warmwater nonnative species that could prey on juvenile razorback suckers. The reduced flows could result in less backwater habitat available in the Grand Canyon, but it could create additional habitat in the inflows to Lake Powell. Because the proposed action could lead to increased predation and competition, it has a potentially negative effect on complex lotic or lentic habitat.

2. Suitable water temperature and quality

Temperatures below the dam are predicted to exceed 16°C during the action period regardless of whether the proposed action is implemented or not (see Figure 5). These temperatures are beneficial for reducing mortality of eggs and improving larval and juvenile growth.
As temperatures increase above 12°C to approximately 22°C, egg survival, larval growth, and recruitment to the juvenile stage increases (Gilbert et al. 2022). Most spawning occurs between February and May (Gilbert et al. 2022). Warmer temperatures that would be expected to occur with reduced flows would be likely to improve larval rearing in the Grand Canyon (if it occurs; none has been observed since 2019). However, warmer temperatures are also likely to benefit warmwater nonnative fish species that are predators and competitors of razorback sucker.

Dissolved oxygen levels in the Glen Canyon Reach may decrease due to increased deltaic sediment resuspension in Lake Powell (Wildman and Hering 2011) and associated dissolved oxygen demand in the reservoir water column. However, this would not impact razorback suckers in the Grand Canyon because the water is oxygenated by the time it reaches Badger Rapid (RM 8). This means that there would not be any additional impact to water quality in Lake Mead beyond the effects already analyzed because Lake Mead is nearly 240 miles (386 km) downriver from Glen Canyon Dam.

The water temperature and quality of the inflows to Lake Powell would not be affected by the proposed action because they are determined by the water that flows in from the San Juan and Colorado rivers.

Water temperatures below Glen Canyon Dam are predicted to exceed 16°C for the proposed action and the no action which is beneficial for razorback suckers. Because razorback suckers are a warmwater fish and prefer warmer temperatures, the proposed action is expected to provide suitable temperatures for the species.

3. Variable flow regimes in lotic systems

The proposed action would include a similar release pattern to LTEMP but at lower volumes (no lower than 6.0 maf; see Table 1). Because the proposed action does not include a change to the flow pattern already analyzed in LTEMP, no change to flow regime is expected.

4. Adequate food supply

If monthly releases are similar to those currently observed, overall food base production and diversity is expected to be similar to what it has been for the past several years (Cross et al. 2013; Hall et al. 2015; Kennedy et al. 2014). Lower monthly releases would be expected to increase food base production for two reasons: 1) with lower volumes, the range in daily fluctuations in stage would decrease, which would be expected to increase survival of sensitive insect eggs and increase overall insect abundance; and 2), and food base production tends to accelerate when flows are low. Water temperature can also affect food base production, but the proposed action is likely to have a positive effect on food base production because the temperatures are expected to be warmer than 12°C. The proposed action is expected to have a positive effect on the food supply because food base production and diversity is expected to be similar or better compared to previous years.

The food supply in Lake Mead is not expected to be affected by reduced releases from Glen Canyon Dam because the release pattern will still follow that described in LTEMP and because the distance between Glen Canyon Dam and Lake Mead is far enough that the affect is expected to be minimal.

Food supply for razorback suckers in the inflows comes from the San Juan and Colorado Rivers which is determined by the water from above Lake Powell and therefore would not be determined by the action.

The proposed action is expected to have a positive effect on the food supply because food base production and diversity is expected to be similar or better from 2024-2026 compared to previous years due to increased temperatures.

5. Range and connectivity

Pearce Ferry Rapid is currently serving as a partial barrier to upstream movement of razorback suckers. The proposed action is not expected to raise the level of Lake Mead to allow upriver passage of razorback suckers from Lake Mead into the Grand Canyon (approximately 1,116 feet) (Bruckerhoff et al. 2022). Pearce Ferry Rapid is currently serving as a partial barrier which limits upriver movement of razorback suckers and nonnative fish species known to occur in the inflow area of Lake Mead (Hedden et al. 2022).

The proposed action is not expected to affect the range or connectivity of razorback suckers in the inflows to Lake Powell because it will not affect the water that flows into Lake Powell from the San Juan or Colorado Rivers and will not change the connectivity of razorback suckers between the inflows and the reservoir. The proposed action will also not change the water levels enough to stop Pearce Ferry Rapid from serving as a partial barrier to upstream fish movement. For all of these reasons, the proposed action will not affect range and connectivity.

6. Population size

The population size of razorback suckers in Lake Powell is unknown, but population estimates have been developed for the San Juan and Colorado River inflows (Table 3; USFWS 2023). Implementation of the proposed action would create additional habitat, but it is unlikely have a population-level effect on razorback suckers because the razorback suckers that utilize the inflows are likely extensions of the populations found in the Green, Colorado, and San Juan Rivers (USFWS 2023), and the proposed action would not remove the connection between the rivers and the lake.

Table 3. Recent Adult Razorback Sucker Population Estimates for the Colorado River and San Juan River Inflows to Lake Powell (USFWS 2023b)

Location	Years	Point Estimate	95% Confidence Interval	Source
Colorado River arm	2010–2016	2,184	1,784–2,713	B. Albrecht, BioWest, unpublished data
San Juan River arm	2011–2012	527	248–1,311	Francis et al. (2017)
San Juan River arm	2017	572	549–595	Cathcart et al. (2018)
San Juan River arm	2018	647	410–884	Pennock and Gido (2019)

Any changes to releases from Glen Canyon Dam are not expected to impact the population size of razorback suckers in Lake Mead because the proposed action would include minor changes to monthly releases and razorback suckers have adapted to changing environmental and hydrologic conditions in Lake Mead for many years without major impacts to the population (Rogers et al. 2022). Warmer temperatures in the Grand Canyon would be expected to be beneficial to egg and early life stage survival although no larval razorback suckers have been detected since 2019.

The proposed action and the no action alternatives are very similar until 2026 when the proposed action results in a slightly higher elevation for the wettest and driest traces. The proposed action could change the location of the inflows, but razorback suckers have adapted to changing water levels in Lake Powell and Lake Mead successfully previously. The warmer temperatures are beneficial for razorback suckers but are unlikely to have a population-level effect. Because the

razorback suckers in the inflows to Lake Powell are extensions of other populations, warmer temperatures would improve spawning conditions razorback suckers in the Grand Canyon, and the Lake Mead populations have adapted to changing environmental conditions, it is possible the proposed action could affect individual razorback suckers, but it is unlikely to have a population-level effect.

7. Multiple interconnected, naturally recruiting and resilient populations

The razorback suckers occupying the inflows to Lake Powell are likely extensions of the populations found in the Green, Colorado and San Juan Rivers (USFWS 2023). A decrease in lake elevation is not expected to change that connection or the number of populations of razorback suckers. This is based on data from Lake Mead which demonstrate that razorback suckers have been able to survive and recruit under a broad range of conditions (Rogers et al. 2023).

No razorback suckers were detected in the Grand Canyon from 1991-2011. However, in 2012 and 2013 two razorback suckers were capture downstream of Spencer Creek (RM 246). A few razorback suckers have been detected occasionally in the Grand Canyon since then. Since 2014, sonic-tagged adult razorback suckers have been released periodically in the Grand Canyon to better understand movements and possibly locate spawning aggregations. Despite monthly surveys conducted from March through September since 2014, no juvenile razorback suckers have ever been detected and larval razorback suckers were initially detected but none have been identified since 2019 (Figure 9). The timing coincides with the changing of Pearce Ferry Rapid to a barrier suggesting it may be preventing migration of razorback suckers upstream from Lake Mead, though a few have been detected upstream suggesting that it is not a complete barrier to upstream movement. If Lake Mead levels were to increase enough to change Pearce Ferry Rapid such that connectivity increases between Lake Mead and Grand Canyon, this may allow for additional individual razorback suckers to access Grand Canyon. However, over the approximately 3-year time frame for the proposed action, substantial changes are not expected to occur at Pearce Ferry Rapid that would increase connectivity.

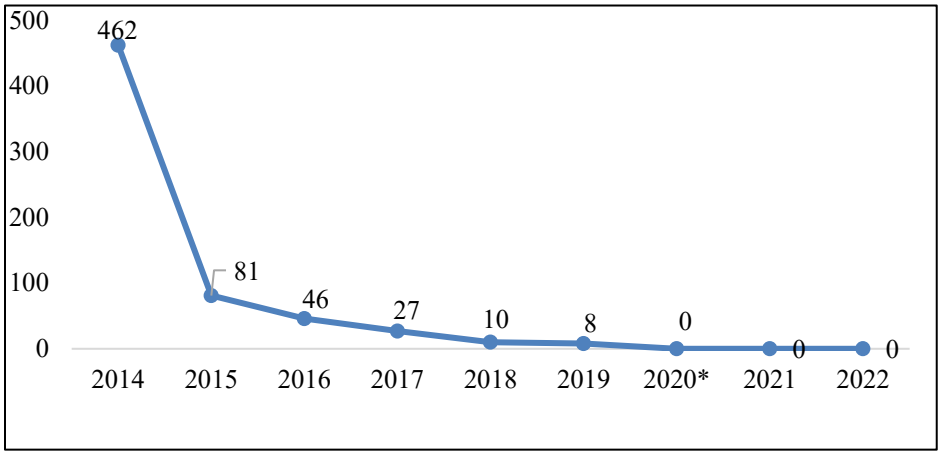


Figure 9. The number of larval razorback suckers identified in the Grand Canyon from 2014-2022 (Reclamation 2022).

The population of razorback suckers in Lake Mead has been successfully reproducing and recruiting for the last several decades despite dam operations and the presence of abundant nonnative fishes. Any changes that may occur due to the proposed action are not expected to be significant enough to have a population-level effect because the Lake Mead populations have been able to survive and recruit under a broad range of conditions (Rogers et al. 2023).

The proposed action is not expected to have a population-level effect because the razorback suckers that are found in the inflows to Lake Powell are likely extensions of other populations, Lake Mead populations have been successfully reproducing for decades with dam operations and the few adult razorback suckers that have been detected would move to deeper areas that would be unaffected by the action.

8. Genetic diversity

The effect on genetic diversity would be highly uncertain, but, decreased genetic diversity is unlikely because there are so few razorback suckers in the Grand Canyon and Pearce Ferry Rapid is already serving as a partial barrier to razorback suckers moving upstream from Lake Mead into the Grand Canyon to spawn. The number of razorback suckers in the Grand Canyon is so low that hybridization with flannelmouth suckers is a concern.

The razorback suckers that are detected in the inflows to Lake Powell are likely extensions of the Green, Colorado, and San Juan Rivers meaning their genetics is determined by spawning in the rivers and not by an adjustment to the location of the inflows. Also, many of the fish are stocked and genetics of stocked fish is determined at the hatchery.

The proposed action is unlikely to affect genetic diversity because there is already a barrier that impedes movement of razorback suckers between Lake Mead and the Grand Canyon, and the razorback suckers in the inflows to Lake Powell would still be able to move between the rivers and the lake.

Determination

Reclamation has determined that the proposed action may affect and is likely to adversely affect razorback suckers because it could affect the complex lotic and/or lentic habitat available to razorback sucker because warmwater nonnative fish could increase which would have a potentially negative effect on razorback suckers in the Grand Canyon.

Razorback Sucker Critical Habitat

Critical habitat for razorback sucker in the action area includes the two major inflows of Lake Powell and the Colorado River downstream of Glen Canyon Dam. Of the two inflows, critical habitat includes the Colorado River and its 100-year floodplain downstream to North Wash near Hite Marina, including the Dirty Devil arm. It also includes the San Juan River and its 100-year floodplain downstream to the mouth of Neskahi Canyon.

The PCEs described in the final rule were water, physical habitat, and the biological environment (59 Federal Register 13374). On February 11, 2016, the USFWS published a final rule implementing changes to the regulations for designating critical habitat (Federal Register 81 7414). The changes included a regulatory definition for the ESA's phrase "physical or biological

features" and elimination of the phrase "primary constituent element". The designation of critical habitat for Razorback Sucker uses the term primary constituent element. The new critical habitat regulations (CFR 402.01 and 402.12) eliminated that term and uses the ESA's phrase PBF. The change does not alter the approach used in conducting a "destruction or adverse modification" analysis. In this consultation document, we use the term PBF to represent the PCEs identified in the final rule for this designated critical habitat.

Water

Water of sufficient water quality should be delivered in sufficient quantity to a specific location in accordance with a hydrologic regime that is required for the particular life stage of each species. Water for the reaches of critical habitat in the Colorado River and San Juan River inflows is provided by the respective rivers with water operations outside of, and not related to, the proposed action.

The proposed action and the no action alternatives include water temperatures below Glen Canyon Dam that are above 16°C (see Figure 5) for much of the year which are beneficial to razorback sucker. Cloud cover and turbidity affect the amount of light that reaches the water's surface and thus the amount of gross primary productivity on short time scales (Hall et al. 2015), whereas monsoonal activity and solar insolation determines the same thing on a larger time scale (Yard et al. 2005). Reduced flows would result in warmer water with less range in daily fluctuations in stage which are associated with higher gross primary productivity.

Because the proposed action would have no effect on the critical habitat for the inflows of the San Juan and Colorado Rivers and the water temperature associated with the action is beneficial for razorback suckers and is associated with increased gross primary productivity, the proposed action is not expected to have an effect on water.

Physical habitat

Physical habitat includes areas of the Colorado River system that are inhabited by fish or potentially habitable for use in spawning, nursery, feeding, or corridors between these areas. In addition to river channels, these areas include bottomlands, side channels, secondary channels, oxbows, backwaters, and other areas in the 100-year floodplain, which when inundated provide spawning, nursery, feeding, and rearing habitats, or access to these habitats.

In the inflows to Lake Powell, the location of the inflows would change slightly with changing elevation of the reservoir. Juvenile and adult razorback suckers would move as the location of the inflows shifts. The rivers would still be connected to the lake meaning there would still be river habitat available for spawning, nursery, feeding and rearing. In the Grand Canyon, backwater habitat might be reduced, but backwater persistence and location shifts with flow and stage of the river and these changes in flow and stage are unlikely to decrease the amount of backwater habitat within riverine sections of the project area. Backwater habitat is also rare and ephemeral and only contains a small portion of the population.

The proposed action is unlikely to affect the physical habitat because above Lake Powell they use the rivers for spawning, nursery and rearing habitats and the action would not change the connection between the rivers and the lake. The proposed action would not affect razorback suckers in the Grand Canyon because the various habitat types would still be available, the location would just shift slightly.

Biological environment
Food supply, predation, and competition are important elements of the biological environment and are considered components of this constituent element. Food supply is a function of nutrient supply, productivity, and availability to each life stage of the species. Predation, although considered a normal component of this environment, is out of balance due to introduced fish species in some areas. This is also true of competition from nonnative fish species. The biological environment is composed primarily of the food base (mainly drifting and benthic aquatic macroinvertebrates) and sympatric fish species that may be predators or competitors. Warm, reduced flows can benefit the razorback sucker and its food production but also warmwater nonnative fish species which could have negative impacts on razorback suckers.

Reduced flows would mean warmer water in the Grand Canyon which would be beneficial for razorback sucker which are a species adapted to warm water (USFWS 2018c). However, warmer water could also be beneficial for other warmwater nonnative fishes which could increase competition and predation.

The proposed action could be beneficial to the food supply because of the warmer water temperatures, but it could increase competition and predation if the warmwater nonnative species such as smallmouth bass increase in numbers or become established.

Determination

Water and physical environment would not be affected by the action and the food supply would be positively affected but predation and competition by warmwater nonnative fishes has the potential to increase. Reclamation has made a no adverse modification determination because while the proposed action may affect some of the PBFs, the total level of effect does not rise to the level of adverse modification.

Colorado Pikeminnow

Analysis of effects of the proposed action on Colorado pikeminnow considered evaluation of eight resources that are most likely to influence species viability as described in the species status assessment (USFWS 2022) and outlined below. The proposed action describes operational guidelines for Lake Powell and Lake Mead and this BA evaluates the effects of the proposed action on resources downstream from Glen Canyon Dam. Colorado pikeminnow are not found below Glen Canyon Dam, and therefore effects are limited to fish and habitat that occur in Lake Powell and the extent that operations of Glen Canyon dam impact habitat and fish upstream of Lake Powell.

1. Variable flow regimes, specifically peak flows to maintain channel complexity and spawning habitats

No Colorado pikeminnow are found in the Colorado River below Glen Canyon Dam where flows would vary with the action. A few Colorado pikeminnow have been detected in the inflows to the Colorado (3 individuals since 2014 from RM 45.9 to RM 130) and San Juan Rivers (13 individuals since 2011 from RM 15 to RM 47) to Lake Powell (STReaMS database http://streamsystem.org) but there is no evidence of spawning or recruitment in the inflows. No effect is expected on spawning habitat or flow regimes due to the proposed action because the proposed action does not affect flows into Lake Powell.

2. Base flows to provide suitable nursery habitats

No suitable nursery habitat for Colorado pikeminnow has been identified in the San Juan or Colorado River arms to Lake Powell. The proposed action is not expected to affect base flows or suitable nursery habitat because the action affects the amount of water released below Glen Canyon Dam, but it does not change the amount of water flowing into Lake Powell from the various tributaries including the Colorado and San Juan rivers where Colorado pikeminnow are located.

3. Suitable water temperatures for spawning and growth

Colorado pikeminnow are not expected to spawn or grow in Lake Powell and spawning and growth occurs in the rivers (San Juan and Colorado) that feed into the lake. The water temperature at the inflows to Lake Powell where Colorado pikeminnow have been detected is determined by inflows from the San Juan and Colorado Rivers. Because the proposed action will have no effect on the rivers above the dam, it will not affect water temperatures associated with spawning and growth.

4. Complex, redundant riverine habitats that provide a combination of the necessary elements of spawning, nursery, and foraging areas

The proposed action could result in a lower elevation of Lake Powell, but this would not affect the complexity of the habitat. It would create some additional river and expose habitat that has already been exposed, but it would take time for the ecosystem to shift to productive habitat that would support spawning, nursery, or foraging. Though a few Colorado pikeminnow have been detected at the inflows to the San Juan and Colorado rivers to Lake Powell, no evidence of spawning, nursery or foraging has been detected at the inflows or in the newly formed river that has been created with decreasing reservoir levels. The proposed action would not affect the riverine habitats that are necessary for spawning, nursery and foraging because Colorado pikeminnow rely on the San Juan and Colorado Rivers for these activities which would not be affected by the action.

5. Abundant, suitable forage base

The main prey base for Colorado pikeminnow is not in the inflows of the San Juan or Colorado Rivers to Lake Powell but higher up in the system in the rivers above the reservoir. Sustained low lake elevations could support additional prey for Colorado pikeminnow in the newly created river, but the shift in the ecosystem is unlikely to occur during the action period. The proposed action will not affect the food base for Colorado pikeminnow because it has no effect on the rivers above Lake Powell.

6. Population size and demographic rates

Colorado pikeminnow rely on river habitat for spawning, growth, and foraging. Although a few Colorado pikeminnow have been detected at the inflows, the action is not expected to have a population-level effect on the population size or demographic rates because they utilize the rivers for various life cycle stages and the proposed action does not affect the rivers above Lake Powell.

7. Multiple naturally recruiting and resilient populations

Colorado pikeminnow are maintained only by stocking in the San Juan River. There are naturally recruiting (self-sustaining populations) on the Green and Colorado Rivers, but they are declining. The proposed action would not affect Colorado pikeminnow populations because they rely on the rivers for spawning, nursery, and rearing and the proposed action has no effect on the rivers above Lake Powell.

8. Genetic and behavioral diversity

The proposed action would have no effect on the genetic or behavioral diversity of Colorado pikeminnow in the San Juan River because it is maintained by stocking; consequently, genetics are determined at the hatchery. The proposed action is also unlikely to have an effect on genetic diversity of the self-sustaining Colorado River populations because Colorado pikeminnow utilize the river for spawning and rearing which would not be affected by the proposed action.

Determination

A few Colorado pikeminnow have been detected in the inflows to Lake Powell but they rely on the river habitat for spawning, nursery, and foraging. The proposed action could change the location of the inflows but does not change the quality of habitat in the river because this is affected by the hydrology above Lake Powell which is not affected by the action. Because the proposed action does not affect the amount of water that flows into the San Juan or Colorado Rivers where Colorado pikeminnow are located and Colorado pikeminnow do not utilize the inflows for spawning, nursery, or feeding, Reclamation has determined that the action may affect but is not likely to adversely affect Colorado pikeminnow.

Colorado Pikeminnow Critical Habitat

Critical habitat for Colorado pikeminnow in the action area includes the two major inflows of Lake Powell: 1) Colorado River and its 100-year floodplain downstream to North Wash near Hite Marina, including the Dirty Devil arm; and 2) San Juan River and its 100-year floodplain downstream to the mouth of Neskahi Canyon. There is no critical habitat for Colorado pikeminnow downstream of Glen Canyon Dam.

The PCEs described in the final rule were water, physical habitat, and the biological environment (59 Federal Register 13374). On February 11, 2016, the USFWS published a final rule implementing changes to the regulations for designating critical habitat (81 Federal Register 7414). The changes included a regulatory definition for the ESA's phrase "physical or biological features" and elimination of the phrase "primary constituent element". The designation of critical habitat for Colorado pikeminnow uses the term primary constituent element. The new critical habitat regulations (CFR 402.01 and 402.12) eliminated that term and uses the ESA's phrase PBF. The change does not alter the approach used in conducting a "destruction or adverse modification" analysis. In this consultation document, we use the term PBF to represent the PCEs identified in the final rule for this designated critical habitat.

Water
Water of sufficient water quality should be delivered in sufficient quantity to a specific location in accordance with a hydrologic regime that is required for the particular life stage of each

species. Water for the reaches of critical habitat in the Colorado River and San Juan River inflows is provided by the respective rivers with water operations outside of, and not related to, the proposed action.

The proposed action and the no action alternatives are very similar. The proposed action is not expected to affect the designated critical habitat because the water affecting the designated critical habitat comes from the rivers above Lake Powell and is not determined by the action.

Physical habitat
Overall, the area of critical habitat is far enough upstream that it will not be affected by reduced releases from Glen Canyon Dam. Habitat used by age-0 and juvenile Colorado pikeminnow includes backwaters and side channels, and habitat used by subadults, and adults includes eddies, deep pools, and runs that are maintained by the respective river flows. Colorado pikeminnow do not tend to use the inflow areas for spawning or nursery areas meaning that this would not affect the species, and the area of critical habitat is far enough upstream that it will not be affected by reduced releases from Glen Canyon Dam (Tildon Jones, USFWS, personal communication).

The proposed action is unlikely to affect the physical habitat because the critical habitat is affected by the water from the rivers above Lake Powell and Colorado pikeminnow utilize the river for spawning and nursery areas.

Biological environment
The biological environment is composed primarily of the food base (mainly drifting and benthic aquatic macroinvertebrates) and sympatric fish species that may be predators or competitors. Food supply, predation, and competition are important elements of the biological environment and are considered components of this constituent element. Food supply is a function of nutrient supply, productivity, and availability to each life stage of the species. The longer the inflow area remains riverine, the food base will start to shift to more riverine habitat which will align more closely with the food base used by Colorado pikeminnow. The proposed action does not change the water that flows from the rivers above Lake Powell and will not affect the critical habitat because it is above the area that will be affected by the action.

Determination

Only a few Colorado pikeminnow have been found in the inflows to Lake Powell which is not surprising because they rely on river habitat for spawning, nursery and feeding. Reclamation has made a no adverse modification for critical habitat because the proposed action does not affect the water that flows from the rivers into Lake Powell or change the physical habitat or the biological environment used by Colorado pikeminnow.

Southwestern Willow Flycatcher

Numbers of nesting southwestern willow flycatchers in the Grand Canyon have declined since the 1980s, and no nests have been confirmed in the Grand Canyon since 2007 (Terwilliger and Holm 2021). Territorial male flycatchers were detected in 2010 and could have been members of breeding pairs, although no mates were detected. In June 2023, two willow flycatchers were observed visually and audibly at 275-mile marsh (NPS 2023). Riparian vegetation in the sites where breeding southwestern willow flycatchers have been detected most recently is not

dependent on flows in the Colorado River. Consequently, the proposed action would have no effect on breeding southwestern willow flycatchers because they do not occur in the Grand Canyon in sites where riparian vegetation is influenced by flow in the mainstem of the Colorado River.

The proposed action could affect riparian vegetation used by migrating willow flycatchers for perching, foraging, and sheltering. Lower water levels would make some areas less suitable for riparian vegetation while promoting the development of riparian vegetation in other areas. The proposed action would increase the likelihood of annual and seasonal variability in flows, including spring high flows. These flows would support emergent aquatic insects; thus, the proposed action would continue providing food sources for migrating willow flycatchers.

Determination

Reclamation has made a may affect but is unlikely to adversely affect determination because no nesting southwestern willow flycatchers are expected to occur in areas affected by flow changes.

Southwestern Willow Flycatcher Critical Habitat

There is no designated critical habitat for southwestern willow flycatchers in the action area and therefore no effect.

Western Yellow-billed Cuckoo

No breeding or probable breeding western yellow-billed cuckoo territories have been detected in Grand Canyon since the late 1990s (Johnson et al. 2007; M. Johnson et al. 2008; Koronkiewicz et al. 2006; McKernan and Braden 2002; McLeod and Koronkiewicz 2009; McLeod et al. 2005, 2007; McLeod, Koronkiewicz, Nichols, et al. 2008), but a single cuckoo detection was recorded at Burnt Springs in 2021 (Terwilliger and Holm 2021). The only current, sizeable stands of riparian vegetation in the Grand Canyon are in sites such as Burnt Springs and RM 275 where vegetation is not dependent on flows in the Colorado River. Consequently, the proposed action would have no effect on breeding western yellow-billed cuckoos because they do not occur in the Grand Canyon in sites where riparian vegetation is influenced by flow in the mainstem of the Colorado River.

The proposed action could affect riparian vegetation used by migrating western yellow-billed cuckoos for perching, foraging, and sheltering. Lower water levels would make some areas less suitable for riparian vegetation while promoting the development of riparian vegetation in other areas.

Determination

Reclamation has made a may affect but is unlikely to adversely affect determination because although the proposed action could affect riparian vegetation used by migrating western yellow-billed cuckoos for perching, foraging, and sheltering, no nesting western yellow-billed cuckoos are expected to occur in areas affected by flow changes.

Western Yellow-billed Cuckoo Critical Habitat

There is no designated critical habitat for western yellow-billed cuckoos in the action area and therefore no effect.

Current Conservation Measures and Other Conservation Actions

Reclamation is responsible for various conservation measures that either address or apply to the proposed action as defined in the 2016 LTEMP BO (USFWS 2016) and the 2007 Interim Guidelines BO (USFWS 2007). In addition, Reclamation is voluntarily supporting many other conservation actions that support threatened and endangered species which are included in this section.

Ongoing Conservation Measures

There are various ongoing conservation measures with many of the ones listed in the 2007 Interim Guidelines BO (USFWS 2007) carried forward in the LTEMP BO (USFWS 2016). The ongoing conservation measures are summarized here and fully incorporated by reference.

- Reclamation continues to support NPS, USFWS, GCMRC, and Glen Canyon Dam Adaptive Management Program (GCDAMP) in funding and implementing translocations of humpback chub into tributaries of the Colorado River in Marble and Grand Canyons, and in monitoring the results of these translocations.
- Reclamation continues to fund a spring and fall population estimate annually, or a different frequency as deemed appropriate in consultation with USFWS, using a mark-recapture based model for the Little Colorado River or the most appropriate model developed for the current collecting techniques and data.
- Reclamation continues to fund control or removal of nonnative fish in tributaries prior to chub translocations depending on the existing fish community in each tributary.
- Reclamation continues to assist the USFWS, NPS, and the GCDAMP to ensure that a stable or upward trend of humpback chub mainstem aggregations can be achieved by:
    - Continuing to conduct annual monitoring of the Little Colorado River humpback chub aggregation and supporting running an open or multistate model to estimate abundance of the entire Little Colorado River aggregation inclusive of mainstem fish.
    - Supporting annual monitoring in the mainstem Colorado River to determine status and trends of humpback chub and continuing to investigate sampling and analytical methods to estimate abundance of chub in the mainstem.
    - Conducting periodic surveys to identify additional aggregations and individual humpback chub.
    - Evaluate existing aggregations and determining drivers of these aggregations.
    - Exploring means of expanding humpback chub populations outside of the Little Colorado River Inflow aggregation.

- Reclamation supports GCMRC to conduct disease and parasite monitoring of humpback chub and other fishes in the mainstem Colorado and the Little Colorado River.
- Reclamation is collaborating with the USFWS, GCMRC, NPS, and the Havasupai Tribe to conduct preliminary surveys and a feasibility study for translocation of humpback chub into Upper Havasu Creek (above Beaver Falls).
- Reclamation would, in cooperation with USFWS, NPS, GCMRC, and AZGFD, explore and evaluate other tributaries for potential translocations.
- Reclamation continues to fund larval and small-bodied fish monitoring to:
    - Determine the extent of hybridization in flannelmouth and razorback sucker collected in the western Grand Canyon.
    - Determine habitat use and distribution of different life stages of razorback sucker to assist in future management of flows that may help conserve the species.
    - Assess the effects of Trout Management Flows and other dam operations on razorback sucker.
- Reclamation, in collaboration with NPS and USFWS, and in consultation with AZGFD continues to investigate the possibility of renovating Bright Angel and Shinumo Creeks with a chemical piscicide, or other tools, as appropriate.
- Reclamation would continue to fund efforts of the GCMRC and NPS to remove brown trout (and other nonnative species) from Bright Angel Creek and the Bright Angel Creek Inflow reach of the Colorado River, and from other areas where new or expanded spawning populations develop.
- Reclamation continues to explore the efficacy of a temperature control device at the dam to respond to potential extremes in hydrological conditions due to climate conditions that could result in nonnative fish establishment.
- Reclamation would pursue means of preventing the passage of deleterious invasive nonnative fish through Glen Canyon Dam. Potential options to minimize or eliminate passage through the turbine or bypass intakes or minimize survival of nonnative fish that pass through the dam would be assessed.
- Reclamation would, in consultation with USFWS and AZGFD, fund the NPS and GCMRC on the completion of planning on and compliance to alter the backwater slough, making it unsuitable or in accessible to warmwater nonnative species that can compete and predate upon native fish, including humpback chub.
- Reclamation would support the completion of planning and compliance of a plan for implementing rapid response control efforts for newly establishing or existing deleterious invasive nonnative species within and contiguous to the action area. Control efforts may include chemical, mechanical, or physical methods.
- Reclamation will consider the experimental use of Trout Management Flows to inhibit brown trout spawning and recruitment in Glen Canyon, or other mainstem locations.

- Reclamation will partially assist in funding NPS to conduct southwestern willow flycatcher surveys once every 2 years for the life of LTEMP.

Additional Conservation Actions by Reclamation to Support Threatened and Endangered Species

The actions described below are additional conservation actions that Reclamation has initiated and/or funded to support ongoing actions beyond existing conservation measures. If the action also applies to an existing conservation measure, clarification is provided on how it is exceeded. Conservation actions that are complete are in regular print and ongoing actions are in italics.

Fish Exclusion

Reclamation supported a prize competition in 2019 called "Improving Fish Exclusion from Water Diversions and Intakes" to address the conservation measure related to preventing fish passage. Six winners were awarded a total of $75,000. A submission summary slide and a 90-second video for each submitted concept was posted on the American Made Challenges website.

The following actions are additional actions Reclamation has pursued that exceed the conservation measure:

- Reclamation funded and worked with its Technical Services Center (TSC) to complete a report (Glen Canyon Dam Fish Escapement Options HL-2022-02) that evaluates options for preventing fish passage through Glen Canyon Dam.
- Reclamation coordinated, organized, and led a subject matter expert panel to talk about options identified in the Glen Canyon Dam Fish Escapement Options report for preventing fish passage and to provide a recommendation for moving forward.
- Reclamation funded and is working closely with the TSC to develop a 30% design for a net to prevent fish passage through the dam.
- *Reclamation approached Utah State University to set up a project to characterize the fish assemblage in the Lake Powell forebay to better understand the risk of fish passage through Glen Canyon Dam. Reclamation is funding and is on the graduate committee for the graduate student involved in this work.*
- *Reclamation funded the TSC to conduct hydroacoustics in the forebay area of Lake Powell in conjunction with the Utah State University graduate student project to better understand the fish community.*

Modifying the Slough

Reclamation worked with its TSC to evaluate "Temperature Reduction Options for Glen Canyon Slough: RM -12 (SRH 2018-17) to address the conservation measure. In the 2018 report, six options were developed for modifying the slough. All the options were discounted by NPS in their 2019 nonnative aquatic species environmental assessment (NPS 2019), and consequently no additional action was taken.

Reclamation pursued the following action which exceeds the conservation measure:

- Reclamation funded the TSC again in 2022-2023 to reevaluate the options for modifying the slough. The engineering report to modify the slough was finalized in summer 2023.

Rapid Response

Reclamation participated in the planning and completion of a plan for implementing rapid response activities (GCMRC 2022). Reclamation funded implementation of the following additional activities to exceed the conservation measure:

- In 2022, Reclamation provided the funding to NPS to support all their costs related to a chemical treatment of the slough to remove smallmouth bass and other warmwater nonnative species.
- Reclamation funded an NPS coordinator and NPS, GCMRC, and Reclamation's TSC staff for their participation in electrofishing efforts in fall 2022 between the dam and the Paria River to remove warmwater nonnative fishes.
- Reclamation coordinated meetings with the other federal agencies within the DOI to develop a Charter for Department of Interior Smallmouth Bass Rapid Response.
- Reclamation provided funding to Colorado State University to analyze some of the larval smallmouth bass collected in 2022 to determine if hatch dates and natal origins could be determined to better understand smallmouth bass spawning below the dam.
- Reclamation provided staff and a contractor to develop an environmental assessment in 2022-2023 to conduct flows meant to disrupt smallmouth bass reproduction. Though ultimately a finding-of-no-significant-impact could not be reached due to the number of comments from the public, the question of where to obtain alternate power, and the cost, Reclamation is converting the effort to a supplemental EIS in 2023-2024 to allow potential implementation of the flows in the future.
- In 2023, Reclamation funded NPS to conduct electrofishing, netting and seining efforts between the dam and Badger Rapid to remove warmwater nonnative fishes.
- Reclamation provided funding to the University of New Mexico to attempt to determine the number of pairs of fish that were responsible for the smallmouth bass that were observed in summer 2022.
- Reclamation is leading monthly smallmouth bass rapid response leadership calls to guide the planning, identify funding, and incorporate lessons learned into future efforts.

Humpback chub

All the actions described below are additional conservation actions that Reclamation is supporting that do not directly relate to a conservation measure.

- Reclamation is funding a study with the Southwestern Native Aquatic Resources and Recovery Center (SNARRC) to better understand the genetics of the humpback chub population in the Grand Canyon.
- Reclamation is providing support to GCMRC and USFWS for a movement study for humpback chub to better understand the movements of the humpback chub in the western Grand Canyon.

- Reclamation is supporting USFWS to develop a plan to prepare to move humpback chub from the western Grand Canyon to the Little Colorado River if the number of adult humpback chub was to decline to a point where translocations become necessary.
- Reclamation is supporting USFWS to better understand how nonnative fishes use the travertine dams in the Little Colorado River.

Razorback Suckers

The action described below is an additional conservation action that Reclamation has pursued that does not directly relate to a conservation measure.

- Reclamation funded and conducted the logistics for an expert science panel to conduct an assessment of potential augmentation and management strategies for razorback sucker in Lake Mead and Grand Canyon (Pennock et al. 2022).
- Reclamation funded a graduate student and served as a committee member on the graduate student committee to explore razorback and flannelmouth sucker hybridization and competition with nonnatives. The purpose of the study was to evaluate differences in egg and juvenile survival and understand morphometric differences in hybrids. The following publications were produced from the work:
    - Wolters, P.N. 2017. Investigations into Razorback Sucker-Flannelmouth Sucker Hybrid Viability and Identification Using Shape. MS thesis, Northern Arizona University, Flagstaff, Arizona. Available at: https://www.proquest.com/docview/1994438449?pq-origsite=primo.
    - Wolters, P.N., D.L. Rogowski, D.L. Ward, and A.C. Gibb. 2019. Viability of razorback-flannelmouth sucker hybrids. *The Southwestern Naturalist* 63(4):280–283. Available at: https://doi.org/10.1894/0038-4909-63-4-280.
    - Wolters-Rinker, P.N., D.L. Rogowski, and A.C. Gibb. 2022. Allometric changes and shape comparisons of two southwestern sucker species and their hybrids using a geometric morphometric approach. *Transactions of the American Fisheries Society* 151(5):630–640. Available at: https://afspubs.onlinelibrary.wiley.com/doi/full/10.1002/tafs.10380.
    - Rogowski, D.L., P. Wolters-Rinker, and C. Nielson. In preparation. Assessment of competition between juveniles of two Catostomids of the Colorado River Basin. *Journal of Fish Ecology*.
- Reclamation is working with and funded Southwestern Native Aquatic Resources and Recovery Center (SNARRC) to design a study to answer additional questions related to the survival, growth, and development of razorback sucker and flannelmouth sucker hybrids. The objectives include determining if interspecific crosses are more successful than intraspecific crosses, identifying morphological differences, and determining the effect of temperature on larval growth and development.

New Conservation Measures

The 2016 LTEMP BO provides coverage for impacts to species for annual releases volumes as low as 7.0 maf. In years when annual releases are above 7.0 maf, the conservation measures as

described in the LTEMP BO will continue, but no additional actions will be taken. For years when the annual release is below 7.0 maf, the new conservation measures listed below are proposed to mitigate the effects of the proposed action.

New conservation measures that will be implemented when annual release volumes are below 7.0 maf include the following:

- Reclamation will design and implement a study to evaluate fish entrainment through Glen Canyon Dam.
- Reclamation will support an annual monitoring of backwaters and other low velocity habitats for nonnative fishes.
- Reclamation will pursue the potential to manipulate flows to reduce the temperature to benefit humpback chub and disadvantage warmwater species.
- Reclamation's Upper Colorado Regional Office and LCR MSCP will coordinate and fund efforts to better understand movements of nonnative species from below Pearce Ferry Rapid into the Grand Canyon.
- Reclamation's Upper Colorado Regional Office will convene an expert science panel (that includes representation from the Humpback Chub Recovery Team and management agencies) that's purpose would be to determine which Humpback Chub population dynamics in the western Grand Canyon population should trigger conservation interventions to prevent population decline. The panel's responsibility would be to evaluate population dynamics in this reach and recommend conservation intervention measures that might be undertaken. This process could be similar to and follow the management triggers plan developed for the Little Colorado River population of Humpback Chub for the LTEMP BO (Young et al. 2015). This plan would be developed prior to the post-2026 plan for GCD operations so as to consider these intervention measures for inclusion in that plan.

Cumulative Effects

Cumulative effects include the effects of future state, local, private, or tribal management actions that may occur in the project area during the duration of the plan. Future federal actions that have not been previously approved are not included in this section because additional ESA Section 7 consultation would be required. The following projects were considered when analyzing cumulative effects of the proposed action, and other non-federal actions, on endangered species.

The Colorado River Watershed within the action area is predominantly managed by the NPS. Since the land within the action area is almost exclusively managed by the NPS, most activities that could potentially affect listed species are federal activities and subject to additional Section 7 consultations.

Humpback Chub and Critical Habitat

Cumulative effects on the humpback chub and its critical habitat outside of NPS lands stem from Native American actions, and state, local, or private actions in tributary watersheds upstream of the action area. Native American use of the Colorado River in Grand Canyon includes cultural, religious, and recreational purposes, as well as land management of tribal lands (e.g., recreational

use including rafting, hunting, and fishing). Reclamation believes that these uses have minimal impacts to humpback chub and its critical habitat due to the small scale at which they occur.

There is the potential for nonnative fish species, including those hosting parasites, to invade the lower Little Colorado River from upriver sources 155 miles (250 km) away during certain flood events traveling through the intermittent river segments (Stone et al. 2007). Nonnative fish species stocked into the area in Arizona utilizing federal funds have been evaluated under Section 7 of the ESA and are not anticipated to significantly affect humpback chub or its critical habitat (USFWS 2018b).

Non-federal actions on the Paria River and Kanab Creek are limited to small developments, private water diversions, and recreation, and are expected to continue to have little effect on humpback chub and its critical habitat because these effects are diffuse over a wide area and are distant from humpback chub and its critical habitat.

Increased uranium mining on state and private lands could increase the amount of uranium, arsenic, and other trace elements in local surface water and groundwater flowing into the Colorado River (Alpine 2010). Uranium, other radionuclides, and metals associated with uranium mines can affect the survival, growth, and reproduction of aquatic biota. However, aquatic biota and habitats most likely to be affected during mine development and operation are those associated with small, ephemeral, or intermittent drainages, which are not areas used by humpback chub or razorback sucker in the action area and do not connect to habitats used by these fish within the action area.

In addition, although the Little Colorado River stretches almost 340 miles (550 km), only the headwaters and the lowermost reaches flow year-round. The lower 13 miles (21 km) of the Little Colorado River is fed by groundwater springs. As stated above, this reach of the Little Colorado River is occupied by the largest self-sustaining population of humpback chub, and the lower 8 miles (13 km) is designated critical habitat. These water sources may also be vulnerable to basin-wide drought and climate change impacting overall habitat availability and the humpback chub. As the population in the basin states grows and expands, municipal, industrial, and agricultural water demand continues to increase. A study in 2012 showed that the demand for Colorado River Basin water may exceed supply before 2060 (Reclamation 2012), which may result in lower Lake Powell levels and changes in flow, sediment, and water temperature regimes in the Grand Canyon.

Razorback Sucker and Critical Habitat

Razorback sucker and its critical habitat in the Grand Canyon would be affected through the same activities as humpback chub and its critical habitat.

In addition, the following cumulative effects would be expected for the section above Lake Powell. Future water depletions from the San Juan River and/or the Colorado River that do not have a federal nexus, and therefore have not completed Section 7 consultation would be considered cumulative effects. On the San Juan River most of these depletions are accounted for in the consultation for Navajo Dam Operations (Reclamation 2006; USFWS 2006). No new water rights can be issued but some of the existing rights are not being completely utilized at this time. As these water rights are more fully utilized, Navajo Dam operations will become more

constrained and Reclamation would have less flexibility in to meet the flow recommendations (USFWS 2006), which would reduce river flow and decrease available habitat for Colorado pikeminnow and razorback sucker.

Contamination from runoff (i.e., sewage treatment plants, feedlots, residential and agricultural development, and atmospheric deposition of contaminants) could affect water quality in the San Juan and Colorado Rivers. A decrease in water quality could adversely affect razorback sucker and Colorado pikeminnow and their critical habitat (USFWS 2006, 2009).

Gradual change in floodplain vegetation from native riparian species to nonnative species (i.e., Russian olive and saltcedar) could occur. This conversion could result in channel narrowing as these nonnative species encroach upon the floodplain. Channel narrowing leads to a deeper channel with higher water velocity which could limit habitat for larval Colorado pikeminnow and razorback sucker which require low-velocity habitats for development.

Increased recreational use (boating, fishing, ORV use, and camping) in the San Juan River is expected to increase as the human population increases. Potential effects include angling pressure, non-point source pollution, increased fire risk, and harassment of native fishes (USFWS 2006, 2009).

Nonnative fish presence in Lake Powell (striped bass, walleye, and channel catfish) constitutes a future threat to Colorado pikeminnow and razorback sucker in the San Juan and Colorado Rivers. When the water elevation of Lake Powell is high enough to inundate a barrier created by a waterfall, striped bass, walleye, channel catfish, and other nonnative fish species can enter the San Juan River (USFWS 2006, 2009).

Colorado Pikeminnow and Critical Habitat

Colorado pikeminnow and its critical habitat would be affected through the same activities as razorback sucker and its critical habitat for the San Juan and Colorado Rivers.

Southwestern Willow Flycatcher

The cumulative effects of the proposed action on southwestern willow flycatchers are relatively small compared with the effects of other factors, especially future hydrology, and the action is not expected to contribute significantly to cumulative impacts along the Colorado River corridor or within the basin at large. The proposed action would have little effect on southwestern willow flycatchers.

Western Yellow-billed Cuckoo

The cumulative effects of the proposed action on western yellow-billed cuckoo are relatively small compared with the effects of other factors, especially future hydrology, and the action is not expected to contribute significantly to cumulative impacts along the Colorado River corridor or within the basin at large. The proposed action would have little effect on western yellow-billed cuckoo.

Conclusions and Determinations of Effect

A summary of effects determinations for the five listed species is presented in Table 4. Analysis of effects determination are based 50 CFR 402.02, in which effects of the action are all consequences to listed species or critical habitat that the proposed action causes, including the consequences of all other activities that are caused by the proposed action. The proposed action causes a consequence if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (see 50 CFR 402.17).

The proposed action and no action alternatives are expected to have very similar effects on listed species (see Figures 5–8). Although some adverse effects are expected to individual fish, Reclamation does not anticipate any substantial population-level effects within the action area due to the short time frame (through 2026) and because there are only a few traces that suggest implementation of the proposed action may be necessary (see Figure 4).

The biggest potential impact to listed species is an indirect effect on humpback chub if a warmwater, nonnative fish such as smallmouth bass were to establish. However, even if this were to occur, it is unlikely the impact would be observed in the timeframe covered by this BA. The proposed action and the no action would have similar likelihoods of causing establishment of invasive fishes.

There is still a large reproducing population of humpback chub in the action area, and in 2022, more larval and small-bodied humpback chub were detected than previous years, suggesting that the warmer water in the mainstem is beneficial to humpback chub. There are also approximately 40,000 to 60,000 humpback chub in western Grand Canyon (Dzul et al. 2023). The action is unlikely to have a direct population-level effect since flows and temperature would be similar to those observed previously.

Lower water levels could change the riparian vegetation used by southwestern willow flycatchers and western yellow-billed cuckoos for perching, foraging, and sheltering, but nesting is not expected to occur in the areas affected by flow changes.

Table 4 Summary of Effects Determinations (listed alphabetically)

Species	Determination	Basis for Determination
Bonytail (*Gila elegans*)	No effect	Although there is not a self-sustaining population in Lake Powell, untagged bonytail have recently been released in the lake; the bonytail were produced at the Wahweap hatchery by random spawning in the ponds and released into the lake (Smith 2022). A single *Gila* spp. was detected at Lees Ferry in July 2023 and although identification has not been confirmed, it is most likely a bonytail that was released in Lake Powell. Reclamation made a no effect determination for bonytail because this is not a self-sustaining population and the bonytail that are released are untagged and considered excess fish.
California condor (*Gymnogyps californianus*)	No effect	The California condor is an endangered species that would not be affected by this action, and the condors released in Arizona are designated as a non-essential, experimental population under the 10(j) rule of the ESA.
Colorado pikeminnow (*Ptychocheilus lucius*)	May affect but is not likely to adversely affect the species	A few Colorado pikeminnow have been detected in the inflows to Lake Powell but they rely on the river habitat for spawning, nursery, and foraging. The proposed action could change the location of the inflows but does not change the quality of habitat in the river because this is affected by the hydrology above Lake Powell which is not affected by the action. Because the proposed action does not affect the amount of water that flows into the San Juan or Colorado Rivers where Colorado pikeminnow are located and Colorado pikeminnow do not utilize the inflows for spawning, nursery, or feeding, Reclamation has determined that the action may affect but is not likely to adversely affect Colorado pikeminnow.
Colorado pikeminnow critical habitat	No adverse modification	Only a few Colorado pikeminnow have been found in the inflows to Lake Powell which is not surprising because they rely on river habitat for spawning, nursery and feeding. Reclamation has made a no adverse modification for critical habitat because the proposed action does not affect the water that flows from the rivers into Lake Powell or change the physical habitat or the biological environment used by Colorado pikeminnow.
Humpback chub (*Gila cypha*)	May affect and is likely to adversely affect the species	Warm water releases from the dam, which are expected to occur for reduced flows, are likely to benefit humpback chub with near optimal growth and spawning temperatures, but these warmer temperatures may also benefit and result in establishment of nonnative fish that prey on and compete with the humpback chub. For the newly established humpback chub population in western Grand Canyon (Separation Canyon to Pearce Ferry), establishment of a warmwater, nonnative predator would likely negatively affect survival of humpback chub, particularly young-of-year and juvenile fish. For these reasons, Reclamation made a determination that the action may affect and is likely to adversely affect the species.

Species	Determination	Basis for Determination
Humpback chub critical habitat	No adverse modification	There is a potential for an increase in warmwater nonnative species that could compete with humpback chub for resources and prey on early life stages. Although the proposed action could affect the biological environment (specifically related to increased competition and predation if a warmwater nonnative fish becomes established), Reclamation has determined that these effects do not rise to the level of adverse modification of designated critical habitat for humpback chub. The remaining PBF parameters will not be adversely affected.
Mexican spotted owl (*Strix occidentalis lucida*)	No effect	Neither this species nor its habitat occurs in the area where activities would be implemented. Therefore, this species is not considered further in this analysis.
Razorback sucker (*Xyrauchen texanus*)	May affect and is likely to adversely affect the species	Reclamation has determined that the proposed action may affect and is likely to adversely affect razorback suckers because it could affect the complex lotic and/or lentic habitat available to razorback sucker because warmwater nonnative fish could increase which would have a potentially negative effect on razorback suckers in the Grand Canyon.
Razorback sucker critical habitat	No adverse modification	Water and physical environment would not be affected by the action and the food supply would be positively affected but predation and competition by warmwater nonnative fishes has the potential to increase. Reclamation has made a no adverse modification determination because while the proposed action may affect some of the PBFs, the total level of effect does not rise to the level of adverse modification.
Sentry milk-vetch (*Astragalus cremnophylax* var. *cremnophylax*)	No effect	Neither this species nor its habitat occurs in the area where activities would be implemented. Therefore, this species is not considered further in this analysis.
Southwestern willow flycatcher (*Empidonax traillii extimus*)	May affect but is not likely to adversely affect the species	Although there was a visual and audible sighting of two southwestern willow flycatchers in 2023, it is the first detection in the action area for several years, and there is very little habitat within the action area (USGS 2023b). Reclamation has made a may affect but is unlikely to adversely affect determination because no nesting southwestern willow flycatchers are expected to occur in areas affected by flow changes.
Southwestern willow flycatcher critical habitat	No effect	There is no designated critical habitat in the action area.
Western yellow-billed cuckoo (*Coccyzus americanus*)	May affect but is not likely to adversely affect the species	No nesting western yellow-billed cuckoos are expected to occur in areas affected by flow changes. The proposed action could affect riparian vegetation used by migrating western yellow-billed cuckoos for perching, foraging, and sheltering. Lower water levels would make some areas less suitable for riparian vegetation while promoting the development of riparian vegetation in other areas.
Western yellow-billed cuckoo critical habitat	No effect	There is no designated critical habitat in the action area.

Species	Determination	Basis for Determination
Yuma Ridgway's rail (formerly Yuma clapper rail) (*Rallus obsoletus yumanensis*)	No effect	Neither this species nor its habitat occurs in the area where the proposed action would have any affect. Therefore, this species is not considered further in this analysis.

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Biological Assessment
for
Short-Term Additional Reduction in Colorado River Flows Between Hoover Dam and the Southerly International Boundary and Activities Provided Under the Lower Colorado River Multi-Species Conservation Program

Bureau of Reclamation
Lower Colorado River Multi-Species Conservation Program

October 2023

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1 PROGRAM BACKGROUND AND INTRODUCTION

The Lower Colorado River Multi-Species Conservation Program (LCR MSCP) is a 50-year, federal/non-federal partnership among 48 permittees that provides Endangered Species Act (ESA) compliance for ongoing and future operations and maintenance activities on the lower Colorado River from April 2005 through April 2055. The Secretary of the Interior approved the LCR MSCP and authorized the Bureau of Reclamation's (Reclamation's) participation in a Record of Decision dated April 2, 2005. The Record of Decision incorporated a number of Program Documents to guide implementation of the LCR MSCP over its 50-year term.[1] Congress subsequently recognized the Secretary of the Interior's authority "to manage and implement the LCR MSCP" in accordance with the relevant Program Documents in the Omnibus Public Land Management Act of 2009 (Public Law No. 111-11, Title IX, Subtitle E, at 123 Stat. 1327-29). The LCR MSCP has been implemented in full compliance with the Program Documents for the past 18 years.

The LCR MSCP planning area extends from full pool elevation of Lake Mead to the Southerly International Boundary with Mexico, spanning over 400 miles and encompassing portions of seven counties in the three Lower Basin States of Arizona, California, and Nevada. Consistent with the Program Documents, Reclamation is the implementing agency for the LCR MSCP and is responsible for completing conservation measures described in the Habitat Conservation Plan (HCP) (LCR MSCP 2004a, and as amended; LCR MSCP 2020a) and Reasonable and Prudent Measures in the 2005, 2018, and 2022 biological opinions (BOs) (U.S. Fish and Wildlife Service [USFWS] 2005a, 2018a, 2022). Reclamation interacts with its partners through the LCR MSCP Steering Committee, which is composed of state and federal agencies, regional water and power users, municipalities, Native American tribes, and conservation organizations, among others, who provide collaborative input and oversight functions in support of LCR MSCP implementation.

The LCR MSCP is a unique program created to meet the need for a comprehensive species conservation program on the lower Colorado River that could address broad and long-term effects related to water management and hydroelectric power activities. Reclamation's water management functions on the lower Colorado River are implemented in accordance with a suite of compacts, laws, rules and regulations, and operating criteria commonly referred to as the "Law of the River." As set forth in detail in the Program Documents, many activities along the lower Colorado River, especially those relating to water delivery and diversions, involve discretionary and non-discretionary actions,[2] both federal actions (e.g., facilities operations at major Colorado River reservoirs) and non-federal activities (e.g., water orders pursuant to existing agreements and contracts), and are interrelated and interdependent; these actions are coordinated to such an extent that attempting to separate out the effects of all relevant actions and activities and assigning each to a particular federal or non-federal agency was not found to be feasible or the optimal approach to species conservation by Reclamation and the USFWS and confirmed by the Secretary of the Interior as set forth in the LCR MSCP Record of Decision and supporting documentation. Given this consolidation of federal actions and non-federal activities on the lower Colorado River, it is not clear

[1] "PROGRAM DOCUMENTS.—The term ''Program Documents'' means the Habitat Conservation Plan, Biological Assessment [BA] and Biological and Conference Opinion [BO], Environmental Impact Statement/Environmental Impact Report [EIS/EIR], Funding and Management Agreement [FMA], Implementing Agreement [IA], and Section 10(a)(1)(B) Permit [Permit] issued and, as applicable, executed in connection with the LCR MSCP, and any amendments or successor documents that are developed consistent with existing agreements and applicable law." Public Law No. 111-11 at Section 9401(3) (emphasis added).

[2] As set forth in the 2004 biological assessment, in many cases, a nondiscretionary federal action is triggered by a state or other non-federal action. For example, the normal delivery of 7.5 million acre-feet annually to water contractors in Arizona, California, and Nevada pursuant to the Decree includes a nondiscretionary federal component (storage and delivery), a discretionary federal component (diurnal water releases), and may include a non-federal component (e.g., the request for and diversion of water by a contractor).

which parties could have specific responsibility under the ESA for any potential take of ESA-listed species.

The LCR MSCP therefore integrates Section 7 and Section 10 responsibilities under the ESA, with no functional separation of effects and the resultant incidental take for the federal and non-federal covered actions. Subsequently, Congress authorized the Secretary of the Interior to implement the LCR MSCP accordingly under Public Law No. 111-11, as discussed above. The LCR MSCP also used habitat impacts as a surrogate for species impacts, as direct species effects were difficult to accurately and appropriately quantify. This was done through the creation of a modeling process that relates habitat extent to specific hydrologic changes resulting from flow-related covered activities. Conservation measures were then developed from the results of this modeling.

As a 50-year program that covers a wide variety of activities, the LCR MSCP provided coverage for a broad range of foreseeable future activities at the time the program was formally adopted in 2005. The past 18 years of program implementation have affirmed the importance of the flexible and forward-looking program coverage contained in the Program Documents. Nothing in this biological assessment (BA) changes the existing, binding commitment of the federal and non-federal LCR MSCP parties to fully implement the LCR MSCP through 2055.

The LCR MSCP parties hold a Section 10 Permit and accordingly, are referred to as non-federal Permittees, as appropriate given the context, in this BA. The approach to initiation of Section 7 consultation set forth in this BA was developed after discussion with members of the LCR MSCP Steering Committee and LCR MSCP participants, and with technical assistance and pre-consultation with the USFWS.

2 FRAMEWORK AND RATIONALE FOR INITIATION OF SECTION 7 CONSULTATION PURSUANT TO THIS BIOLOGICAL ASSESSMENT

Reclamation, through this BA, is requesting consultation on the following actions: 1) increasing the amount of reduction in flow coverage provided under the LCR MSCP in Reaches 2 through 5 (from Hoover Dam to Imperial Dam) in the range of 2.083 to 3.0 million acre-feet per year (mafy), from the current coverage of 1.574 mafy; and 2) implementing proposed conservation measures, including minimization measures, additional monitoring and research, and habitat creation as an integral part of the proposed action to fully offset the potential effects on species and their habitats associated with the requested increases in flow reductions. The LCR MSCP will continue to implement existing conservation measures associated with previous BOs (2004, 2018, 2022) that contribute to offsetting the potential effects on species and their habitats associated with covered activities referenced in those prior BOs and potential effects associated with the current proposed action (see Section 6 for a detailed description of the proposed action).

The proposed action is important to facilitate water conservation and operational actions that are designed to minimize the risk of the ongoing historic drought in the Colorado River Basin causing Lake Mead to decline to dead pool,[3] preventing water deliveries to water users in Arizona, California, Nevada, and the Republic of Mexico. Reaching dead pool would not only affect downstream water deliveries, it would also have catastrophic impacts on species present in downstream riparian and aquatic areas.

[3] Dead pool refers to elevations at which water cannot be regularly released from a reservoir.

Among the listed actions and activities identified in the Program Documents, the LCR MSCP provides ESA take coverage for flow-related activities, including power production and changes to the points of diversion of Colorado River water and associated reductions in water releases from Hoover, Davis, and Parker Dams. Reductions in flow in Reaches 2 through 5 (from Hoover Dam to Imperial Dam) up to 1.574 mafy are currently covered under the LCR MSCP.

Since the start of implementation of the LCR MSCP in 2005, the types of water projects and transactions have expanded. In addition to transfers from one water user to another, as initially contemplated in the LCR MSCP, multiple innovative water conservation actions have been put in place to allow for water to be stored or contributed to Lake Mead for the purpose of protecting Lake Mead elevations considering the ongoing historic drought in the Colorado River Basin. The successful implementation of these water conservation actions has been essential to protecting water supplies in recent years, especially given the extended drought and low-runoff conditions. The importance of these efforts cannot be overstated: since 2007, these efforts have provided for almost 100 feet of water elevation in Lake Mead. Absent these efforts, water releases would have been reduced over the past 6 years, with associated impacts to agricultural, urban, and environmental water uses (Figure 2-1).

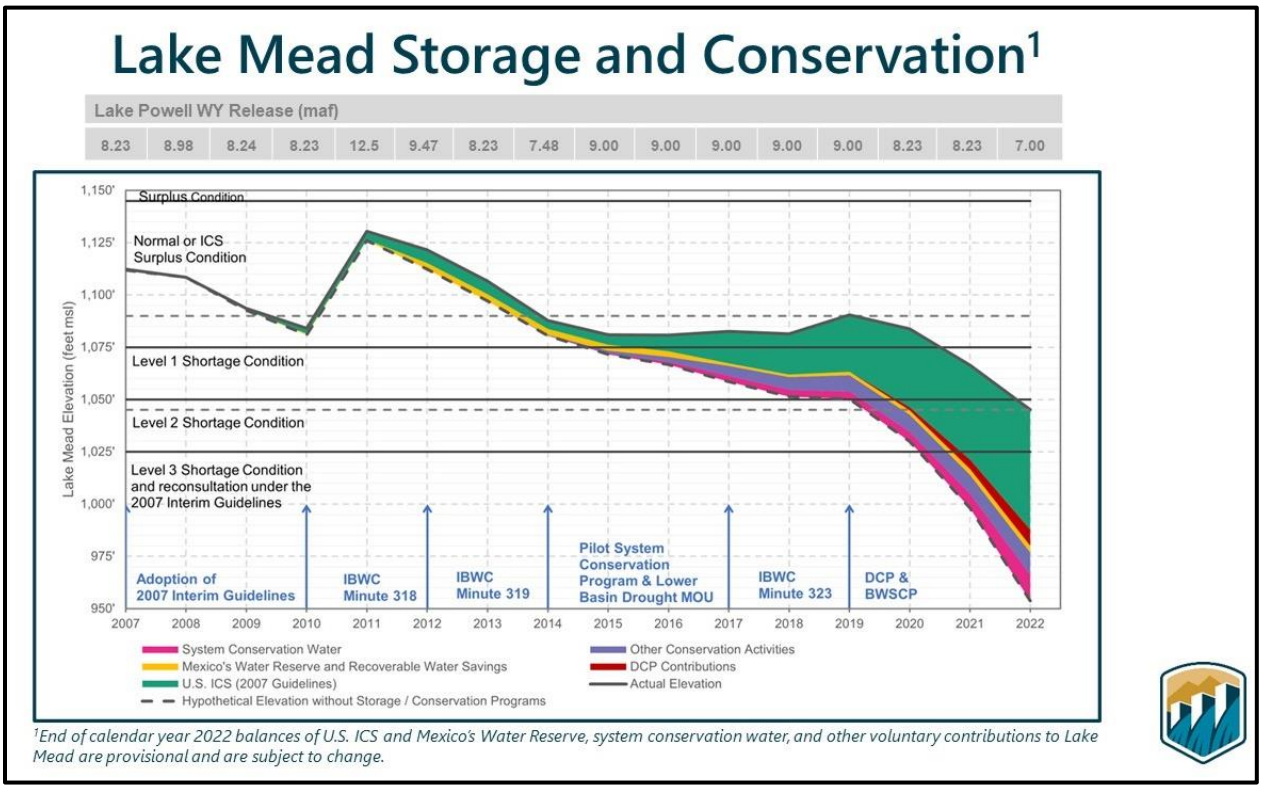


Figure 2-1. Lake Mead conservation levels.

BWSCP = Binational Water Scarcity Contingency Plan, IBWC = International Boundary Water Commission, ICS = Intentionally Created Surplus, maf = million acre-feet, MOU = Memorandum of Understanding, msl = above mean sea level, WY = water year

In 2019, Reclamation and representatives from the Lower Basin States signed the Lower Basin Drought Contingency Plan (DCP) to address the ongoing historic drought in the Colorado River Basin. Congress directed the Secretary of the Interior to enter into DCPs in the Colorado River Drought Contingency Plan Authorization Act.[4] Since implementation of the DCP, Reclamation and LCR MSCP partners have used water conservation actions to address current and near-term risks resulting from climate change and

[4] Colorado River Drought Contingency Plan Authorization Act, Pub. L. No. 116-14 (April 16, 2019) (133 Stat. 850).

extended drought. Despite these efforts to stabilize Lake Mead levels, on August 16, 2021, Reclamation released the *Operation Plan for Colorado River System Reservoirs, August 2021 24-Month Study* (Reclamation 2021a). In addition to projecting Lake Mead elevations to be less than 1,075 feet on January 1, 2022, triggering the first Tier 1 Shortage reduction in the Lower Basin in history (under the 2007 Colorado River Interim Guidelines [Reclamation and U.S. Department of the Interior [Interior Department] 2007]), the Minimum Probable projection showed Lake Mead falling below 1,030 feet during the succeeding 2-year period. At this elevation, Lake Mead contains only approximately 5.6 million acre-feet (maf)—a mere 22% of the full capacity of Lake Mead—and would place system users at excessive risk of Lake Mead reaching dead pool and not being able to release water to downstream users.

This projection triggered a mandatory consultation (1030 Consultation) requirement between the United States and the Lower Basin parties pursuant to the congressionally approved DCP. The Lower Basin Drought Contingency Plan Agreement - Exhibit 1 to Attachment B, Section V. B. 2, states, in pertinent part, that the United States and Lower Basin parties are committed:

> "…to individual and collective action to avoid and protect against the potential for elevations in Lake Mead to decline to elevations below 1,020',"
>
> "…If any 24-Month Study for the minimum probable inflows projects that Lake Mead will be at or below 1,030' anytime within the succeeding two Years, the Secretary [of the Interior] and Lower Division States shall consult and determine what additional measures will be taken." (1030 Consultation)

After the 1030 Consultation in August 2021, the United States and the Lower Basin parties met to address the critical water supply situation to identify, develop, and implement the additional actions needed to protect the 1,020-foot above mean sea level elevation at Lake Mead during 2022. These contemplated actions were in addition to the reductions and contributions already required under the 2007 Interim Guidelines and the DCP and related agreements. A series of modeling efforts revealed that at least 500,000 acre-feet (af) or more per year would need to be conserved in 2022 and 2023, with a commitment to continued actions from 2024 through 2026, to meet the commitments set forth in the DCP Agreements to protect Lake Mead's elevation from dropping further to critically low elevations that would place the Lower Basin (and Mexico) at heightened risk of Lake Mead reaching dead pool and being unable to release water to downstream users. These discussions resulted in the 2021 Lower Basin Memorandum of Understanding called the 500 Plus Plan.

To allow for the increased water conservation in the Lower Colorado River Basin consistent with the requirements under the DCP, the 500 Plus Plan, and related agreements, Reclamation sought to increase the amount of reduction in flow coverage in Reaches 2 and 3 up to 1,574,000 acre-feet per year (afy), from the then-current coverages of 845,000 afy and 860,000 afy, respectively.[5] Reclamation reinitiated consultation with the USFWS in 2022, and the USFWS issued a BO for this increased coverage in Reaches 2 and 3 (USFWS 2022).

Despite continued conservation efforts and due to the continuing drought, the Interior Department and Reclamation recognized that even further additional efforts would be needed to protect Lake Mead from potentially reaching dead pool (reservoir elevation 895 feet above mean sea level), to protect the downstream Colorado River water delivery system, and to protect the downstream environment. On June 14, 2022, Reclamation Commissioner Camille Calimlim Touton testified before the Senate Committee on Energy and Natural Resources. During her testimony regarding Lake Mead, she stated that "between 2

[5] The original LCR MSCP provided for reduction in flow coverage in Reaches 4 and 5 of 1,574,000 afy when Reclamation reinitiated consultation in 2022.

and 4 million acre-feet of additional conservation is needed to just protect critical elevations in 2023" (C-SPAN 2023).

On August 16, 2022, the Interior Department issued a press release accompanying the *Colorado River Basin August 2022 24-Month Study* (Reclamation 2022). The press release announced that Lake Mead would operate in its first ever Level 2a Shortage due to the January 1, 2023, Lake Mead elevation projection being between 1,045 and 1,050 feet. The press release also outlined a number of administrative actions that Reclamation would immediately initiate to identify additional mechanisms that would assist in further protecting reservoir levels.

On October 28, 2022, the Interior Department announced that Reclamation would publish a notice of intent to prepare a supplemental environmental impact statement (SEIS), which would include proposed alternatives to revise the 2007 Record of Decision associated with the Colorado River 2007 Interim Guidelines. On November 17, 2022, Reclamation published the notice of intent in the *Federal Register* announcing its intent to prepare the SEIS. A draft SEIS was released to the public in April 2023 which contained analysis of three different alternatives being considered. During the 2022–2023 snow accumulation season, the Colorado River Basin received above average precipitation resulting in the basin-wide snow water equivalent reaching its peak on April 7, 2023, at 161% of median. This above average precipitation provided some relief to the low reservoir conditions across the basin but did not eliminate the need for modified operating guidelines in the interim SEIS period.

Shortly after the release of the draft SEIS, the Interior Department announced a consensus-based proposal agreed on by the three Lower Division States on May 22, 2023. This announcement also stated that the Interior Department was withdrawing the draft SEIS published in April and that an updated draft would be completed later in 2023 that would include analysis of the Lower Basin Plan (i.e., the consensus-based proposal). This updated draft SEIS is currently scheduled to be published in fall 2023. Preliminary modeling results of the SEIS no-action alternative and the Lower Basin proposal (SEIS Proposed Action) is shown in Figure 2-2.

To accommodate modified operations (i.e., reductions in releases from Hoover, Davis, and Parker Dams)[6] under the SEIS proposed action alternative, Reclamation is seeking to increase the amount of reduction in flow coverage in Reaches 2 through 5 in the range of 2,083,000 to 3,000,000 afy, from the current coverage of up to 1,574,000 afy. This increase in flow coverage would continue through issuance of a new BO to cover new or revised Colorado River Post-2026 Operations or through January 31, 2028, whichever occurs sooner (this period is referred to as the interim coverage period throughout the rest of the document). This interim coverage period will provide sufficient time to conduct the following items: update the environmental baseline in accordance with the ESA; validate and update assumptions used in the impacts analysis for this and past consultations; and allows Reclamation, other federal agencies, and Section 10 LCR MSCP Permittees to consult on the preferred alternative that will be identified through the National Environmental Policy Act (NEPA) process that Reclamation has begun to address long-term Colorado River operations (Colorado River Post-2026 Operations). Due to the current NEPA schedule for the Colorado River Post-2026 Operations, it is unlikely that an ESA consultation on the preferred alternative could be completed prior to the signing of the Record of Decision for Colorado River Post-2026 Operations.

Based on the proposed reductions being considered under the Lower Basin Plan in the SEIS and near-term hydrologic projections, Reclamation is seeking to increase coverage for reductions in flow in

[6] These reductions include shortage volumes in accordance with the 2007 Interim Operating Guidelines, contributions in accordance with the DCP, system conservation in accordance with the Lower Basin Plan, and potential federal discretionary actions associated with a potential new Minute under negotiation to the 1944 Water Treaty with the Republic of Mexico.

Reaches 2 through 5 up to 2,083,000 afy, herein defined as the base action. This reduction in flow accommodates reductions that are relatively certain to occur during the interim coverage period.

Reclamation is also seeking coverage, if needed, for reductions in flow in Reaches 2 through 5 up to 3,000,000 afy, herein defined as the expanded action. The reductions in flow associated with this proposed expanded action are less likely to occur, and currently available information does not allow Reclamation to make predictions with a high level of certainty. During the interim coverage period, there are certain low-probability scenarios where up to 3,000,000 afy of reductions in flow could occur, and therefore, Reclamation is seeking coverage for this expanded action to retain operational flexibility during the interim coverage period. See Section 6 for a detailed description of the proposed base action (increased reduction in flow up to 2,083,000 afy) and the increased volume reduction from 2,083,000 afy up to 3,000,000 afy under the expanded action.

Reclamation is also including conservation measures as part of the proposed actions to offset the potential impacts to species and habitat (see Sections 6.4 and 10) during this interim coverage period and habitat creation conservation measures that will continue to be fulfilled through the term of the LCR MSCP. Reclamation will collaborate with the USFWS during this interim coverage period on additional long-term compliance under the ESA and in concert with the NEPA process that Reclamation has already initiated to address Colorado River Post-2026 Operations.

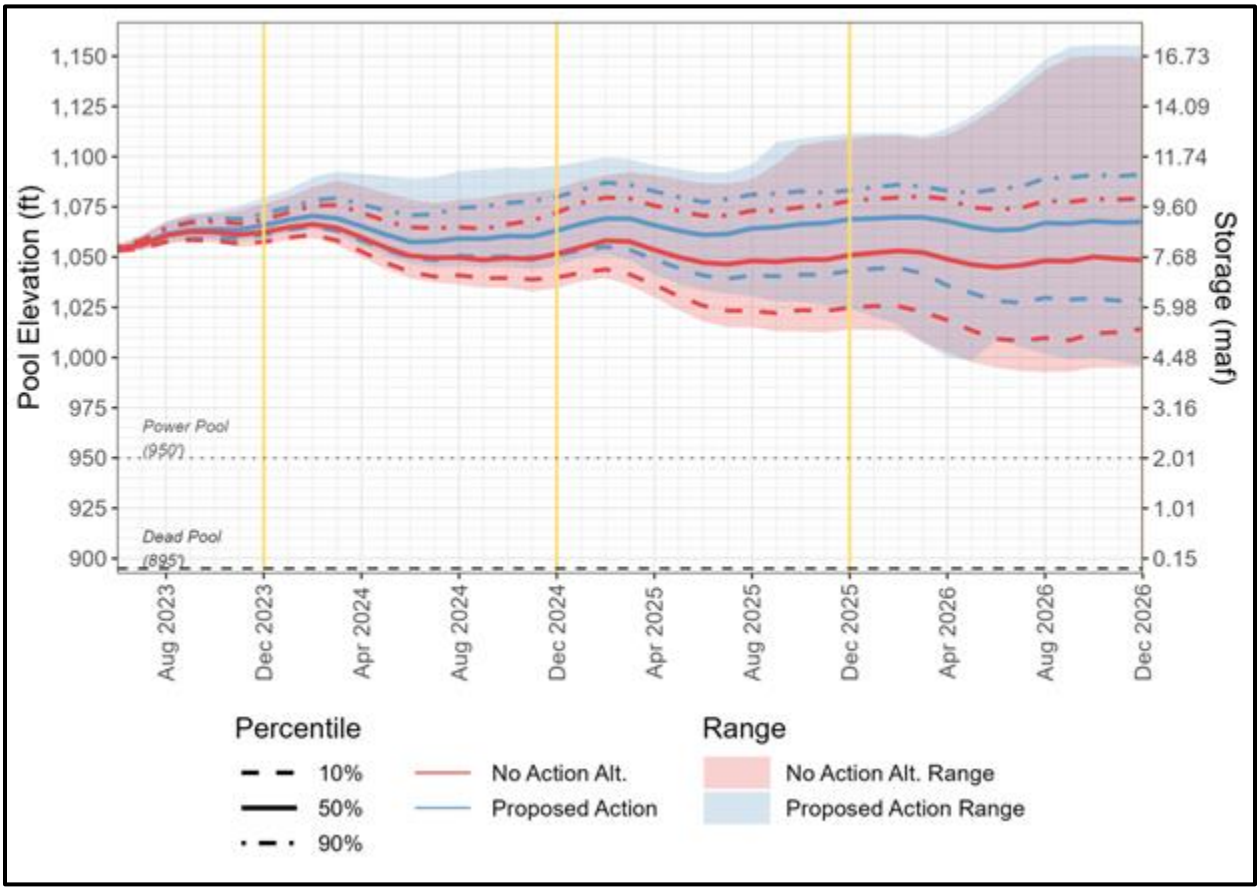


Figure 2-2. Range of modeled potential hydrology scenarios under the SEIS No Action and SEIS Proposed Action scenarios being analyzed in the SEIS under the NEPA.

Alt. = alternative, maf = million acre-feet.

After consulting with the LCR MSCP Steering Committee and the USFWS, Reclamation concluded that pursuing a Section 7 consultation in accordance with this BA provides the most appropriate mechanism to simultaneously accomplish four goals:

1) ensure continued full implementation of the LCR MSCP as an integrated Section 7/Section 10 effort;
2) ensure continued full compliance with the ESA for the needed and essential water conservation actions through an increase in reduction in flow coverage in Reaches 2 through 5 considering the critically low elevation projections at Lake Mead;
3) ensure the ability to take immediate urgent action to conserve water during this interim coverage period to protect Lake Mead until Reclamation establishes new guidelines for Colorado River Post-2026 Operations and all necessary compliance is in place; and
4) gather and analyze necessary information to perform an impacts analysis and initiate LCR MSCP consultation on the new guidelines for Colorado River Post-2026 Operations. It is anticipated that the new guidelines for Colorado River Post-2026 Operations will necessitate appropriate revisions to the LCR MSCP for the remaining term through 2055.

The proposed water conservation actions that would be facilitated by increased flow-related coverage in Reaches 2 through 5 involve Reclamation and non-federal LCR MSCP participants. While proceeding under Section 7(a)(2) of the ESA, Reclamation's analysis contained in this BA addresses all effects of the anticipated federal and non-federal water conservation actions. Although not directly using a formal modification of the non-federal Permittees' Section 10 Permit to address the additional flow coverage, the non-federal Permittees are treated as applicants[7] in this process and the analysis set forth in this BA addresses any/all potential effects of any actions by the non-federal Permittees in furtherance of the water conservation actions required by the DCP, the 500 Plus Plan, the revisions to the 2007 Interim Guidelines which will be finalized in the anticipated Record of Decision for the SEIS, and related agreements. The non-federal LCR MSCP Permittees are aware of this BA, the approach set forth herein, and have either actively supported or not objected to implementation of this BA's proposed conservation measures. Further, after discussions among Reclamation, the non-federal LCR MSCP Permittees, and the USFWS, the approach used in this BA 1) is the most appropriate regulatory approach given the four goals set forth above, and 2) fully addresses the requirements and obligations of the relevant Section 10 Permit held by the non-federal LCR MSCP parties with respect to the requested change in coverage. It is the intent of Reclamation and the non-federal Permittees that the contact and authorization requirements of the Section 10 Permit be met through this BA and resulting consultation with respect to all effects of the revised flow coverage modifications.[8]

[7] The members of the LCR MSCP Steering Committee have been notified and Reclamation has not received any objections to the adopted approach contained in this BA. Reclamation intends to fully honor Paragraph 8 of the LCR MSCP Implementing Agreement which provides, in relevant part that in the event of a Section 7 consultation (as this BA is initiating), "Permittees shall be treated as applicants in any such Section 7 consultation and be entitled to fully and completely participate in all matters involved in such consultation or re-initiation of consultation." (Implementing Agreement at 17 [April 4, 2005]). Reclamation does not believe that the flow-related and habitat protection actions set forth in this BA require an amendment as was done previously upon the listing of the northern Mexican gartersnake (*Thamnophis eques megalops*), given the four primary objectives set forth supra.

[8] See, e.g., NATIVE ENDANGERED SP. HABITAT CONSERVATION PLAN ENDANGERED WILDLIFE Permit Number: TE086834-1 at Section Q-3: "If during the tenure of this Permit, the Covered Activities and/or the extent of the habitat impact described in the LCR MSCP are altered, such that there may be an increase in the anticipated Take of Covered Species, Permittees are required to contact the USFWS and obtain authorization and/or amendment of this Permit before commencing any activities that might result in Take beyond that described in Chapter 4 of the HCP" (emphasis added). It is the intent of Reclamation and the non-federal Permittees that the contact and authorization requirements of the HCP Permit be met through this BA and resulting consultation with respect to all effects of the revised flow coverage modifications.

2.1 Relationship with Previous Biological Opinions

The Record of Decision that established the LCR MSCP was signed on April 2, 2005, and references the 2004 HCP (LCR MSCP 2004a) and 2004 BA (LCR MSCP 2004b) which both contain a description of the covered activities, the effects of those activities that may result in incidental take, and the proposed conservation measures intended to minimize and mitigate impacts from any incidental take of the covered species. Reclamation's obligations as set forth by the 2005 Record of Decision and associated documents will continue; this BA is intended to increase the magnitude of flow-related covered activities for the short-term period associated with the SEIS (see Section 6 for more detail of the proposed actions). Due to the long-term nature of the LCR MSCP, this BA proposes both long-term habitat creation conservation measures (to continue through 2055) and short-term conservation measures (to continue until January 31, 2028, or issuance of a new BO to cover new or revised Colorado River Post-2026 Operations, whichever occurs sooner). The term of the original LCR MSCP has not changed, and Reclamation and its partners will continue to fulfill all long-term obligations until 2055.

The impacts analysis used in the 2004 HCP (LCR MSCP 2004a) and 2004 BA (LCR MSCP 2004b) are described in Sections 4.2 and 5.2 of those documents, respectively. To maximize the proactive approach to impact analysis and associated conservation benefit to the covered species, it was assumed that future changes in points of diversion (i.e., reductions in flow in Reaches 2 through 5) would take place in their entirety at the beginning of the program's term even though the actual timing of implementation was not known (see Section 5.2.1.2 of the 2004 BA [LCR MSCP 2004b]). Additionally, to benefit the conservation actions under the HCP (LCR MSCP 2004a) and BA (LCR MSCP 2004b), the species protections were required whether or not the assumed changes took place during the term of the program. These assumptions carried over to the associated impacts on covered species and their habitats. Mitigation to fully offset these impacts was scheduled accordingly with the goal of creating replacement habitat as soon as practically possible. Over the first 18 years of fully successful implementation of the 50-year LCR MSCP, Reclamation has established 7,048 acres (86%) of the required 8,132 acres required in accordance with the HCP (LCR MSCP 2004a) and BO (USFWS 2005a) (Table 2-1). This strategy of creating replacement habitat as soon as practically possible will be continued for the habitat creation conservation measures included to offset the impacts of the proposed base action.

In 2017, Reclamation reinitiated consultation on the LCR MSCP with an amendment to add the northern Mexican gartersnake (*Thamnophis eques megalops*) as a covered species resulting in a BO issued by the USFWS in 2018 (USFWS 2018a). The impacts analysis for the northern Mexican gartersnake used the same methodology and assumptions as the 2004 analyses. Mitigation to offset impacts to the northern Mexican gartersnake was included in the BA (LCR MSCP 2017) and has been scheduled accordingly in coordination with the mitigation obligations from the 2005 LCR MSCP. Reclamation's obligations under the 2018 BO (USFWS 2018a) will continue through 2055.

In 2022, Reclamation reinitiated consultation with the USFWS to increase coverage in Reaches 2 and 3. The same assumptions applied to the analysis performed in the 2022 BA (LCR MSCP 2022)—the reductions in flow were assumed to take place in their entirety at issuance of the 2022 BO and are assumed to continue through the 2055 original term of the LCR MSCP. Mitigation to offset these impacts was included in the BA (LCR MSCP 2022) and has been scheduled accordingly in coordination with the mitigation obligations from the 2005 LCR MSCP. Reclamation's obligations under the 2022 BO will continue through 2055.

The purpose of and need for the SEIS is to modify certain sections of the 2007 Interim Guidelines for the operation of Glen Canyon Dam and Hoover Dam to address historic drought and low runoff conditions in the Colorado River Basin. In order to accommodate the modified operations being considered under the Lower Basin Plan and near-term hydrologic projections, Reclamation is seeking coverage under the ESA

for up to 2,083,000 afy of flow reduction that is likely to occur. Due to the uncertainty regarding the timing of the SEIS Conservation and other circumstances that may influence operations during the interim coverage period, Reclamation is including a proposed expanded action for reductions in flow greater than 2.083 mafy up to 3.0 mafy to assure that river operations are not adversely impacted due to insufficient environmental compliance coverage. The probability of reductions in flow being greater than 2.083 mafy are low, but there are certain circumstances that would necessitate these increased reductions. Section 6 provides a detailed description of both the base action and the potential expanded action. The impacts analysis performed for this consultation applies the same assumptions as those used in 2004 and 2022: that the base action reductions in flow are assumed to occur at issuance of the BO and species protections are required whether or not the base action reductions (up to 2.083 mafy) in flow occur.

Table 2-1. LCR MSCP ESA Coverage History for Flow Reductions and Associated Impacts and Mitigation

MSCP 1.0	**MSCP 1.1**	**MSCP 1.2**
2004 HCP/2005 BO	2022 BO (Increased Coverage for DCP and 500+ Plan)	Coverage for SEIS - modifications to 2007
Timeframe	**Timeframe**	**Timeframe†**
2005-2055	2022-2055	2024-2028
Lake Mead Coverage	**Lake Mead Coverage**	**Lake Mead Coverage**
1,229-foot Full Pool to 950-foot Power Pool	1,229-foot Full Pool to 950-foot Power Pool	1,229-foot Full Pool to 950-foot Power Pool

Reduction in Flow Coverage		**Reduction in Flow Coverage**		**Reduction in Flow Coverage†**	
Reach 2	845,000 acre-feet	Reach 2	1.574 maf	Reach 2	2.083 – 3.0 maf
Reach 3	860,000 acre-feet	Reach 3	1.574 maf	Reach 3	2.083 – 3.0 maf
Reaches 4 and 5	1.574 maf	Reach 4 & 5	1.574 maf	Reaches 4 and 5	2.083 – 3.0 maf

Land Cover Type	**Impact (acres)***	**Mitigation (acres)**	**Established as of 2022 (acres)**	**Land Cover Type**	**Additional Impact (acres)***	**Additional Mitigation (acres)**	**Mitigation (acres)**	**Land Cover Type (acres)**	**Additional Impact (acres)***	**Additional Mitigation (acres)**	**Mitigation (acres)**
Cottonwood-willow	3,122	5,940	4,482	Cottonwood-willow	0	–	5,940	Cottonwood-willow‡	_	_	5,940
Honey mesquite	610	1,320	2,046	Honey mesquite	0	–	1,320	Honey mesquite	0	_	1,320
Marsh	243	512	362	Marsh	7.5	15	527	Marsh‡	41	41	568
Backwater	399	360	158	Backwater	15	15	375	Backwater	109	109	484
Total	**4,374**	**8,132**	**7,048**	**Total**	**22.5**	**30**	**8,162**	**Total**	**150**	**150**	**8,312**

* Impacts are worst case and assumed to be permanent even if impacts never actually occur; all existing cottonwood-willow (*Populus* spp.–*Salix* spp.) and mesquite (*Prosopis* spp.) were assumed to be lost due to flow-related covered activities (with exceptions)

† The proposed base action (2.083 maf reduction in flow) is considered relatively certain to occur while the proposed expanded action (3.0 maf reduction in flow) is considered less likely to occur, but is included to provide for operational flexibility and to assure that river operations are not adversely impacted due to insufficient environmental compliance coverage

‡ Potential impacts to Topock Marsh are not included in these figures but are discussed in Section 4, Section 7, and Section 10

In summary, Reclamation and its partners will continue to fulfill all long-term obligations under the 2005 (USFWS 2005a), 2018 (USFWS 2018a), and 2022 (USFWS 2022) BOs as well as the short-term (until January 31, 2028 or issuance of a new BO to cover new or revised Colorado River Post-2026 Operations, whichever occurs sooner) and long-term (through 2055) obligations that will be required as a result of this consultation. Reclamation will also work with the USFWS during this interim coverage period on additional long-term compliance under the ESA and in concert with the NEPA process that Reclamation has already initiated to address long-term Colorado River operations.

In addition to conservation measures contained in this BA and what will be proposed in future consultations, a key part of the LCR MSCP is the Adaptive Management Program as described in Section 5.12 of the HCP (LCR MSCP 2004a). The LCR MSCP has relied on the Adaptive Management Program to incorporate newly acquired information in the implementation of conservation activities. The Adaptive Management Program has a habitat monitoring component that provides the necessary information to analyze whether created habitat meets the habitat requirements of the covered species and provides the intended conservation benefit.

3 STATUS OF SPECIES/CRITICAL HABITAT AND ENVIRONMENTAL BASELINE

3.1 Northern Mexican Gartersnake (*Thamnophis eques megalops*)

3.1.1 Species Description, Life History, Population Dynamics

3.1.1.1 BEHAVIOR

The northern Mexican gartersnake is considered a terrestrial and aquatic generalist (*Federal Register* 78:41499–41547). Long-distance movements and concentrated foraging behavior are not anticipated during the cooler seasons in the action area; however, northern Mexican gartersnakes have been observed as being active during the day when the night temperatures are above 32 degrees Fahrenheit (°F) (personal communication, Jeff Servoss, Fish and Wildlife Biologist, USFWS, to Carrie Ronning, Wildlife Group Manager, Bureau of Reclamation, 2023) at lower elevations, such as those within the action area.

The northern Mexican gartersnake forages along watercourses and seeks shelter in thick streamside vegetation (Degenhardt et al. 1996), burrows, and under debris, rocks, etc. The northern Mexican gartersnake was observed demonstrating a wide variety of foraging methods including ambushing prey in water and on land, actively foraging in riffles, vegetation mats, grass, and open water, and feeding in areas where there are temporary concentrations of prey (Rosen and Schwalbe 1988). The Mexican gartersnake (*Thamnophis eques*), including the northern subspecies (*Thamnophis eques megalops*), primarily forages along the shoreline of the water source but occasionally dives in water, forages away from the shoreline, and forages on the water surface (Drummond and Macías García 1989). Mexican gartersnakes have been observed hanging from holes between the rocks with their head in the water and catching fish as they swam by (Conant 2003:16).

The northern Mexican gartersnake can be difficult to detect due to its secretive nature, ability to quickly escape underwater, and ability to persist in low population densities (*Federal Register* 78:41499–41547, 78:41549–41608). Additionally, the northern Mexican gartersnake coexists with other species of gartersnakes across their distribution (Rosen and Schwalbe 1988; Tanner 1959).

3.1.1.2 HABITAT

In Arizona, Rosen and Schwalbe (1988) found that the most important habitat characteristics for the northern Mexican gartersnake were permanent water, dense bankline vegetation, and an abundance of prey species. Surveys and observations of northern Mexican gartersnakes in Mexico suggest that dense vegetation is most important as protective cover where the gartersnake occurs with harmful nonnative species, but in largely or wholly native communities, vegetation density is much less important to survival (Burger 2007). Individuals often remain concealed under surface cover or subsurface in burrows and are found in areas with protected backwaters, braided side channels, beaver ponds, isolated pools near the mainstem of the river, edges of dense emergent vegetation, dried-up channels, ample downed and vegetative cover, and flooded areas (Emmons and Nowak 2013). Surveys in Mexico for the northern Mexican gartersnake found the species to be abundant in areas where habitat was severely degraded with no or low vegetation cover but had few or no harmful nonnative species present and maintained a suitable native prey base, suggesting that in the absence of harmful nonnative species, dense vegetation is less important in maintaining healthy gartersnake populations (Burger 2007). Studies have shown that northern Mexican gartersnakes usually stay within 49 feet (15 meters) of a water source while actively foraging (a direct function of preferred prey) but will move farther away on occasion for gestation, periods of dormancy, ecdysis (shedding) cycles, etc. (Rosen and Schwalbe 1988). They have been observed from over 500 feet (Emmons 2014) to over 1 mile away (personal communication, Roger Cogan, Conservation Coordinator, to Jeff Servoss, Biologist, U.S Fish and Wildlife Service and Taylor Cotton, Gartersnake Coordinator, Arizona Game and Fish Department, , 2015) from the water for sheltering purposes, foraging on land, and moving to other water sources or hibernation sites (Nowak et al. 2011; Rosen and Schwalbe 1988; *Federal Register* 78:41499–41547, 78:41549–41608).

3.1.1.3 SHELTERING HABITAT

Northern Mexican gartersnakes take shelter or cover in dense herbaceous vegetation, dense emergent vegetation, holes, root crevices, submergent vegetation, debris dams, downed logs or trees, rocky areas or rock piles, animal burrows, and human-made cover such as riprap or debris piles (Conant 2003; Emmons and Nowak 2013; Nowak et al. 2011; Rosen and Schwalbe 1988; personal communication, Taylor Cotten, Gartersnake Project Coordinator, to Laura Beth Sabin, Wildlife Biologist, Bureau of Reclamation, 2015). The presence of small-diameter trees provides additional habitat complexity, thermoregulatory opportunities, and cover for the northern Mexican gartersnake (*Federal Register* 79:38678–38746).

3.1.1.4 HABITAT USED DURING PROLONGED INACTIVITY

The northern Mexican gartersnake will use areas of cover with optimal thermal requirements for cover during periods of prolonged inactivity (personal communication, Taylor Cotten, Gartersnake Project Coordinator, to Laura Beth Sabin, Wildlife Biologist, Bureau of Reclamation, 2015). Steep hills, riverbanks, upland burrows, and cliffs adjacent to riparian areas near permanent water sources can provide such areas for the species (Nowak et al. 2011). Individuals will also use small mammal burrows, packrat middens, debris piles, flood debris drifts, rock piles, and retaining wall riprap (personal communication, Taylor Cotten, Gartersnake Project Coordinator, to Laura Beth Sabin, Wildlife Biologist, Bureau of Reclamation, 2015).

3.1.1.5 BREEDING

Exact timing of breeding events varies with elevation (Rosen and Schwalbe 1988). Mating occurs in fall and spring, and females store the sperm until ovulation in late March or early April (Rosen and Schwalbe 1988). Northern Mexican gartersnake females give birth to live young from late May through early July

(Brennan and Holycross 2006; Rosen and Schwalbe 1988; Wallace 2002). Manjarrez (1998) noticed that births were positively correlated with temperature.

Females can have up to 38 young during one breeding season (Nowak and Boyarski 2012), and the size of the litter is positively correlated with the length of the female (Manjarrez 1998; Rosen and Schwalbe 1988). Female northern Mexican gartersnakes have been found to bear young in warm microenvironments 5 to 15 meters from the water, using rock walls, the ground, and sun-warmed sacaton (*Sporobolus* spp.) tussocks (Rosen and Schwalbe 1988), but may give birth in a variety of microhabitats and distances from water. The breeding season is estimated to occur between March and July (March–May mating; May–August live birth).

3.1.1.6 DIET

Potential prey along the mainstem of the lower Colorado River include the Woodhouse's toad (*Anaxyrus woodhousii*), invertebrates, lizards, and small mammals (Cotten 2011; Cotten and Grandmaison 2013; Rorabaugh et al. 2004). Potential prey species found along the Bill Williams River are the Arizona toad (*Anaxyrus microscaphus*), red-spotted toad (*Anaxyrus punctatus*), longfin dace (*Agosia chrysogaster*), invertebrates, lizards, and small mammals (Cotten 2011; Cotten and Grandmaison 2013). Small size classes of harmful nonnative fish may also be used as prey including largemouth bass (*Micropterus* sp.), black bullheads (*Ameiurus melas*), and American bullfrogs (*Lithobates catesbeianus*) (Emmons and Nowak 2016).

3.1.1.7 STATUS AND DISTRIBUTION

Status

The northern Mexican gartersnake is the only subspecies of the Mexican gartersnake that occurs in the United States and is listed as a threatened species under the ESA (*Federal Register* 78:41549–41608). The USFWS designated critical habitat for this species on May 28, 2021, but the action area was excluded from the critical habitat designation because of conservation provided by the LCR MSCP and other entities (*Federal Register* 86: 22518–22580). The species is also:

- S2 T3 in NatureServe, [9]
- a Tier 1 Species of Greatest Conservation Need (SGCN) in Arizona,
- not listed in the California Natural Diversity Database (there are apparently no records of this species from the California counties along the Colorado River), and
- not listed by the Nevada Natural Heritage Program. It is noted as a historic species.

Distribution

Range Wide

Range wide, the species exists between elevations of 130 and 8,497 feet amsl. In Arizona, the species is known to exist in several locations, including the Page Springs and Bubbling Ponds State Fish Hatcheries along Oak Creek, lower Tonto Creek, upper Santa Cruz River in the San Rafael Valley, Bill Williams River and its tributaries, and the upper and middle Verde River. In New Mexico, the species has been recently documented along the Gila River and Mule Creek.

[9] For all status definitions in this section, G = global population of a species, T = subspecific or variety taxonomic level, S = state population of a species, subspecies or variety. 1 = critically imperiled, 2 = imperiled, 3 = vulnerable, 4 = apparently secure, 5 = secure. S#S# indicates uncertainty about the exact status of a taxon.

REASONS FOR LISTING AND CURRENT THREATS

The population is listed under the ESA as threatened. Reductions in range and population densities have affected the status of the northern Mexican gartersnake significantly in the last 30 years. The subspecies occurs at low to very low population densities or may even be extirpated in as much as 90% of the northern Mexican gartersnake's historical distribution in the United States. As of 2016, there were only five northern Mexican gartersnake populations in the United States where the subspecies remains reliably detected and is considered viable, and all are in Arizona. The five known populations are: 1) the Page Springs and Bubbling Ponds State Fish Hatcheries along Oak Creek; 2) lower Tonto Creek; 3) the upper Santa Cruz River in the San Rafael Valley; 4) the Bill Williams River; and 5) the upper and middle Verde River. The Page Springs and Bubbling Ponds State Fish Hatcheries support the largest known populations of the species (Boyarski et al. 2019). As many as 23 of 33 known northern Mexican gartersnake localities in the United States (70%) are likely not viable and may exist at low population densities that could be threatened with extirpation or may already be extirpated (personal communication, Jeff Servoss, Fish and Wildlife Biologist, USFWS, to Carrie Ronning, Wildlife Group Manager, Bureau of Reclamation, 2023).

Northern Mexican gartersnake populations have declined primarily from interactions with harmful nonnative species such as bullfrogs, crayfish, and predatory fish. These nonnative species prey on or compete with the northern Mexican gartersnakes and the native prey species that are vital to their existence. While checking Gee minnow traps at Topock Marsh, a northern Mexican gartersnake was identified as being partially consumed by a crayfish (Bourne et al. 2021). Landscape-level effects from the continued expansion of harmful nonnative species have changed the spatial orientation of the northern Mexican gartersnake's distribution, creating greater isolation between populations. The prey base of these northern Mexican gartersnakes includes native amphibians and fish populations. Declines in their prey base have led to subsequent declines in the distribution and density of gartersnake populations. In most areas across their range, prey base declines are largely attributed to the introduction and expansion of harmful nonnative species (*Federal Register* 79:38678–38746).

Human activities that diminish surface water or degrade streamside (riparian) vegetation, urbanization, and road construction and use are also significant threats, but particularly where they co-occur in the presence of nonnative species (*Federal Register* 79:38678–38746).

Analysis of the Species/Critical Habitat to Likely be Affected

Although there is only one known population of northern Mexican gartersnake along the mainstem of the lower Colorado River (at Topock Marsh on Havasu National Wildlife Refuge [NWR]), due to their secretive nature there is potential for them to occur throughout the lower Colorado River where emergent vegetation and riparian vegetation is present. Therefore, the analysis assesses suitable habitat, not just known occupied areas in Reaches 3 through 5.

Although critical habitat was designated for the species in 2021, the action area was excluded from the critical habitat designation because of conservation provided by the LCR MSCP and other entities.

Environmental Baseline

STATUS OF SPECIES WITHIN THE ACTION AREA

There is no designated critical habitat within the action area. All populations of northern Mexican gartersnake on the lower Colorado River are considered regionally significant. The population on the Havasu NWR at Topock Marsh and the Beal Lake Conservation Area is the only one known to exist along the mainstem of the lower Colorado River. The only other populations connected to the watershed are those along the Bill Williams River and its tributaries the Big Sandy and Santa Maria Rivers. These

areas were proposed as critical habitat by the USFWS in 2020 (USFWS 2020a) and met the criteria for designation. The proposed critical habitat units within the LCR MSCP planning area and off-site mitigation areas were excluded from designation (*Federal Register* 86: 22518–22580) due to the inclusion of the northern Mexican gartersnake as a covered species under the LCR MSCP, the commitment to implement conservation for the species for the term of the permit, and the combined success of conservation efforts of the LCR MSCP and other land managers to create and manage habitat that benefits the northern Mexican gartersnake and other native aquatic and riparian-dependent species.

At the time the LCR MSCP was established in 2005, the northern Mexican gartersnake was considered extirpated from the area surrounding the mainstem of the lower Colorado River and had not been considered as a potential covered species. The species was redocumented between 2010 and 2013, below Alamo Dam on the Bill Williams River and later in its largest tributaries (Baker et al. 2019; Bergamini et al. 2018; Cotten 2011; Cotten and Grandmaison 2013; Cotten and Leavitt 2015; O'Donnell et al. 2019; Rozanski et al. 2022). In 2015, it was documented on the lower Colorado River on the Havasu NWR within the Beal Lake Conservation Area in Mohave County, Arizona (USFWS 2015) and at the Glory Hole site on Topock Marsh (Bourne and Hammer 2020).

The Arizona Game and Fish Department (AZGFD) conducted surveys for the Colorado River toad (*Bufo alvarius*) and the lowland leopard frog (*Rana yavapaiensis*) in suitable habitat within the LCR MSCP planning area from south of Davis Dam to the Southerly International Boundary and the Bill Williams River from east of Planet Ranch west to the confluence with Lake Havasu, from 2010 to 2013 (Cotten 2011; Cotten and Grandmaison 2013; Cotten and Leavitt 2015). Lentic (of, relating of, or living in still waters such as lakes, ponds, or swamps) and lotic (of, relating to, or living in actively moving water) backwaters and desert washes that appeared to provide suitable habitat for the toad and frog were surveyed using funnel trap arrays, visual encounter surveys, and nocturnal audio surveys. During these surveys, 13 northern Mexican gartersnakes were captured in funnel traps along the Bill Williams River upstream of Planet Ranch (Cotten 2011; Cotten and Grandmaison 2013; Cotten and Leavitt 2015). It was uncertain at that time if additional areas of the lower Colorado River were occupied. The northern Mexican gartersnake can be secretive and difficult to detect especially if present in low densities (Emmons and Nowak 2013; personal communication, Taylor Cotten, Gartersnake Project Coordinator, to Laura Beth Sabin, Wildlife Biologist, Bureau of Reclamation, 2015). The surveys from 2010 to 2013 were targeted for the frog and toad, not the northern Mexican gartersnake, and may not have detected gartersnakes as the methods, trap placement, location, and timing would be different depending on the targeted species (personal communication, Taylor Cotten, Gartersnake Project Coordinator, to Laura Beth Sabin, Wildlife Biologist, Bureau of Reclamation, 2015).

In the spring of 2015, the Great Basin Bird Observatory notified the AZGFD, USFWS, and U.S. Geological Survey (USGS) that they may have observed a northern Mexican gartersnake at the Beal Lake Conservation Area on the Havasu NWR in Arizona in Reach 3 during riparian bird monitoring. Five photographs were provided for identification. A gartersnake was observed on May 4, 2015, in the same area, and two additional photographs were taken for identification. The USFWS notified the LCR MSCP on June 1, 2015, that the species was confirmed as a northern Mexican gartersnake by Taylor Cotten and Tom Jones of AZGFD and Jeff Servoss of the USFWS.

Northern Mexican gartersnake distribution and abundance within the Beal Lake Conservation Area is not well known at this time. The detections in 2015 were on a road in the cottonwood-willow (*Populus* spp.–*Salix* spp.) riparian habitat at the Beal Lake Conservation Area adjacent to an area known as Willow Marsh. In 2019, the USFWS conducted a study at six sites in Havasu NWR within Topock Marsh and the Beal Lake Conservation Area and detected 15 individual northern Mexican gartersnakes: seven at Beal Lake Conservation Area in Willow Marsh and eight at the Glory Hole (Farm Ditch Road) site on Topock Marsh (Bourne and Hammer 2020) (Figure 3-1 and Figure 3-2 and Figure 3-3). Captures included males

and females and two juveniles. In 2021, a partially predated northern Mexican gartersnake was found at Topock Marsh (Bourne et al. 2021).



Figure 3-1. Occupied habitat at Willow Marsh in Beal Lake Conservation Area on Havasu NWR.

(Source: Hammer 2019)



Figure 3-2. Occupied habitat at Glory Hole (Farm Ditch Road) on Havasu NWR.
(Source: Hammer 2019)



Figure 3-3. Vegetation at the occupied habitat (left) at Willow Marsh in Beal Lake Conservation Area and (right) at Glory Hole (Farm Ditch Road) on Havasu NWR.
(Source: Hammer 2019)

In 2018, surveys were conducted along the Swansea Reach of the Bill Williams River, 12.4 miles downstream from Alamo Dam. In total, 9,817 trap-hours were conducted. No northern Mexican gartersnakes were identified through trapping or visual encounter surveys (Bergamini et al. 2018).

Surveys continued on the Bill Williams River to learn more about northern Mexican gartersnake distribution, abundance, and habitat. In 2019, AZGFD detected the species in the Bill Williams River approximately 23 miles east of Parker Dam through funnel trapping (O'Donnell et al. 2019). During northern Mexican gartersnake surveys along the Bill Williams River in 2019 and 2020, AZGFD documented prey, including invasive species. Species identified included lowland leopard frog, California kingsnake (*Lampropeltis californiae*), invasive crayfish, Sonoran desert toad (*Incilius alvarius*), red-spotted toad, Arizona toad, six species of nonnative fish, and an invasive clam (Baker et al. 2019). Invasive fish included western mosquitofish (*Gambusia affinis*), red shiner (*Cyprinella lutrensis*), largemouth bass, and green sunfish (*Lepomis cyanellus*).

AZGFD conducted surveys in 2022 along the Big Sandy River, Santa Maria River, and Threemile Lake (Rozanski et al. 2022). Threemile Lake is the closest known location to the Colorado River, and within its historic floodplain, but is currently disconnected from and 0.4 mile east of the Colorado River. After 35,900 trap-hours, no northern Mexican gartersnakes were trapped or observed (Rozanski et al. 2022). In total, 498 vertebrates (495 fish and three amphibians) were observed at Threemile Lake, including largemouth bass, bluegill (*Lepomis macrochirus*), striped bass (*Morone saxatilis*), western mosquitofish, and American bullfrog.

Species presence and absence in other areas of the lower Colorado River is still unknown as species-specific surveys have not been conducted. Northern Mexican gartersnakes are known as a very cryptic species, which could result in low species observations (USFWS 2020a). The LCR MSCP has reviewed the existing literature and coordinated with biologists knowledgeable of the species to predict the potential for observing gartersnakes based on the habitat type and species preferences. It is also important to note that due to the mild winter temperatures in the area (rarely below freezing for long periods of time) and preliminary findings from telemetry research along the Verde River, the snakes may exhibit more surface activity than previously suspected and may be more active in the winter months along the lower Colorado River compared to other locations.

Management Needs, Existing Management Actions, and Recovery Goals

The creation or restoration of marshes and creation of cottonwood-willow habitat adjacent to areas with marsh vegetation will be implemented to benefit the northern Mexican gartersnake (Reclamation 2018b). Large marshes and marshes associated with backwaters that are disconnected from the lower Colorado River channel are of higher value to northern Mexican gartersnake than connected backwaters on the lower Colorado River and are the preferred type to achieve LCR MSCP conservation goals for this species. Marsh associated with disconnected backwaters are managed to limit nonnative predatory species to the extent practicable.

Existing conservation measures listed in this section are currently being implemented as written in the HCP (LCR MSCP 2004a), 2018 Amended HCP (Reclamation 2018b), and 2022 *Biological Opinion for Enhanced Habitat Protection and Reduction in Colorado River Flows Between Hoover Dam and Parker Dam in Excess of Flow-Related Covered Actions and Activities Provided Under the Lower Colorado Multi-Species Conservation Program* (USFWS 2022). Conservation measure NMGS1 states that 512 acres of marsh will be created and managed to provide northern Mexican gartersnake habitat. This created habitat will also be managed for the Yuma Ridgway's rail (*Rallus obsoletus yumanensis*)[10] (HCP conservation measure CLRA1). Of the 5,940 acres of LCR MSCP–created cottonwood-willow habitat, 984 acres will be created and managed near marshes to provide northern Mexican gartersnake habitat. Conservation measure NMGS2 provides for implementation of measures to avoid or minimize take of the northern Mexican gartersnake as provided through LCR MSCP best management practices. These

[10] Yuma Ridgway's rail (*Rallus obsoletus yumanensis*) is also known as Yuma clapper rail (*Rallus longirostris yumanensis*).

practices will be developed in coordination with the USFWS and may include measures addressing worker education programs, speed limits, seasonal restrictions, backfilling or covering trenches overnight, and effects of nonnative species. Avoidance and minimization measures AMM1, AMM2, AMM4, AMM5, and AMM6 outlined in the HCP would also apply to the gartersnake. These measures are ongoing and will be implemented to benefit the northern Mexican gartersnake, except where implementation would negatively affect other covered species. Since the measures are beneficial to all the covered species, there may be temporary negative impacts that rise to the level of take, but overall, the measures will benefit the northern Mexican gartersnake. Monitoring and research measure MRM2 would also apply.

In addition to and independent of Reclamation and LCR MSCP conservation activities, the AZGFD's conservation and mitigation program has committed to either stocking (with captive-bred stock) or securing two populations of northern Mexican gartersnakes to help minimize adverse effects on these species from their sport fish stocking program through 2021 (USFWS 2011:Appendix C). Other AZGFD conservation and mitigation program commitments (independent of LCR MSCP activities) include: 1) developing a northern Mexican gartersnake monitoring, research, and restocking plan to guide conservation and mitigation program activities to establish or secure populations; 2) developing outreach material to reduce the deliberate killing or injuring of northern Mexican gartersnakes (placed in high angler access areas); 3) ensuring that chemically renovated streams are quickly restocked with native fish for northern Mexican gartersnake prey; 4) conducting a live-bait assessment team to develop recommendations to amend live-bait management; 5) reviewing and updating outreach programs on the risks to native aquatic species from the transport of nonnative aquatic species; 6) developing and implementing a public education program on northern Mexican gartersnakes; and 7) working with the New Mexico Department of Game and Fish to examine the role of escaped rainbow trout (*Oncorhynchus mykiss*) from Luna Lake into tributaries to the San Francisco River in supporting narrow-headed gartersnakes (*Thamnophis rufipunctatus rufipunctatus*).

The recovery plan for the northern Mexican gartersnake has not yet been prepared; there are no agency-mandated recovery goals for the northern Mexican gartersnake at this time.

3.2 Yuma Ridgway's Rail (*Rallus obsoletus yumanensis*)

3.2.1 Species Description, Life History, Population Dynamics

3.2.1.1 HABITAT

The Yuma Ridgway's rail generally lives in freshwater and brackish marshes dominated by cattail (*Typha* spp.) and bulrush (*Scirpus* spp.) with a mix of riparian tree and shrub species (willows [*Salix exigua* and *S. gooddingii*], saltcedar [*Tamarix* spp.], arrowweed [*Pluchea sericea*], and *Baccharis* spp.) along the shoreline of the marsh (Anderson and Ohmart 1985; Eddleman 1989; Gould 1975; Smith 1975; Todd 1986; USFWS 2010). Along the lower Colorado River, such habitats are generally found in backwaters or in the impoundments behind dams (USFWS 2010). At the Salton Sea, marsh habitats are created in fields or cells with managed water levels (USFWS 2010). Along the lower Gila, Virgin, and Muddy Rivers, marshes are found along the margins of the river and wetted floodplain (USFWS 2010). At the Cienega de Santa Clara in Mexico, the marsh is large and dense with vegetated areas interspersed with shallow open-water areas (Hinojosa-Huerta et al. 2000). In other areas of Mexico, the subspecies is associated with brackish marshes dominated by dense stands of saltcedar with an understory of iodine bush (*Allenrolfea occidentalis*), and coastal estuaries, some containing mangroves (Rhizophoraceae) and others containing dense glasswort (*Salicornia* spp.) mats, saltgrass (*Distichlis* sp.), and panicgrass (*Dichanthelium* sp.) (Harrity and Conway 2018).

In 2010, the estimated amount of Yuma Ridgway's rail habitat totaled 10,551 acres in the United States and 18,532 acres in Mexico (USFWS 2010). The literature suggests that optimal breeding habitat contains a mosaic of emergent vegetation averaging greater than 6 feet high (Anderson and Ohmart 1985; Eddleman 1989); shallow (less than 12 inches deep) open-water areas either as channels or pools with either minimal daily water fluctuation (Gould 1975; Tomlinson and Todd 1973) or areas available that remain shallow as water levels fluctuate (Dodge and Rudd 2017); and open dry ground (slightly higher than the water level) between water, vegetation, or marsh edge for foraging and movement (Anderson and Ohmart 1985; Conway et al. 1993; Eddleman 1989; Gould 1975). The wide range of home range and activity area sizes indicates that Yuma Ridgway's rails can successfully inhabit a range of marsh sizes; however, the mosaic of habitat features must be met within the area (USFWS 2010).

3.2.1.2 BREEDING

Home ranges are generally smallest during the early and late breeding seasons (March–July) at 17 to 20 acres and largest in the post breeding period (August–October) at 37 acres and late winter period (January–February) at 59 acres (Conway et al. 1993). Both sexes have similar home range sizes except in the post-breeding season, when females averaged about 51 acres and males 22 acres (Eddleman 1989). Home ranges were found to overlap extensively. Eddleman (1989) found great seasonal variations in home ranges (for males, the largest was 24.0 hectares [ha] ± 15.7 standard deviation [SD], n = 6 in January and February and the smallest was 3.6 ha ± 2.8 SD, n = 9 during incubation; for females, the largest was 21.0 ha ± 8.7 SD, n = 8 and the smallest was 2.2 ha ± 1.9 SD, n = 4 during incubation).

The Yuma Ridgway's rail begins nesting activities by February. Young hatch in the first week of June and suffer high mortality from predators in their first month of life (Rosenberg et al. 1991).

3.2.1.3 DIET

Crayfish are a primary food source of this subspecies along the lower Colorado River and may be a limiting factor restricting Yuma Ridgway's rail occurrence (Eddleman 1989; Ohmart and Tomlinson 1977). Other food items include small fish, isopods, insects, spiders, freshwater shrimp, clams, and seeds (California Department of Fish and Game 1991; Eddleman and Conway 1998; Rosenberg et al. 1991).

Rosenberg et al. (1991) list several unique qualities of the Yuma Ridgway's rail that may be pertinent to conservation planning efforts. For example, relative to other subspecies, the Yuma Ridgway's rail has an ability to colonize new habitats because of its partly migratory behavior and the prompt dispersal of juveniles following breeding. In addition, it effectively uses food resources characteristic of freshwater marshes.

3.2.1.4 STATUS AND DISTRIBUTION

Status

The Yuma Ridgway's rail is listed as endangered under the federal ESA and threatened under the California Endangered Species Act.

The Yuma Ridgway's rail is also:

- a G5T3 (global rank),
- N3 (national rank),
- A Tier 1 SGCN and S3 (state rank) in Arizona,

- S1S2 (state rank) in California, and
- S1 (state rank) in Nevada.

Distribution

Range Wide

In 2005, the Yuma Ridgway's rail occurring primarily along the lower Colorado River in California, Arizona, and Sonora, Mexico, was considered one of seven North American subspecies of Ridgway's rails. In 2014, the American Ornithological Society recognized a change in the species name from Yuma clapper rail (*Rallus longirostris yumanensis*) to the Yuma Ridgway's rail (*Rallus obsoletus yumanensis*) (Chesser et al. 2014; Maley and Brumfield 2013). The previous clapper rail (*Rallus longirostris*) was split into three species. The western three resident subspecies of *Rallus longirostris* became subspecies of *Rallus obsoletus*: *yumanensis* (in the lower Colorado River area), *levipes* (in coastal southern California), and *obsoletus* (in coastal marshes of the San Francisco Bay area).

The Yuma Ridgway's rail has a range that extends from Nevada, California, and Arizona to Baja California and Sonora, Mexico. They are regularly detected during breeding season along the lower Colorado River from Topock Marsh south to Yuma, Arizona, in the United States and at the Colorado River Delta in Mexico. Some individuals are resident year-round, whereas others migrate between the lower Colorado River and coastal estuaries along the Gulf of California in Sonora, Mexico (Harrity and Conway 2018, 2020). There are also populations of this subspecies at the Salton Sea in California (Garrett and Dunn 1981); Ash Meadow National Wildlife Refuge, Overton Wildlife Management Area (Harrity and Conway 2020), Las Vegas Wash (Van Dooremolen 2012) and the lower Virgin and Muddy Rivers (Nevada Department of Wildlife 1999) in Nevada; and along the Gila and Salt Rivers to Picacho Reservoir and Blue Point in central Arizona (Rosenberg et al. 1991). Yuma Ridgway's rails have also been detected less frequently and in small numbers at Laughlin and the Virgin River in southern Nevada (McKernan and Braden 2001a; Nevada Department of Wildlife 1998).

REASONS FOR LISTING AND CURRENT THREATS

The survey results for the Yuma Ridgway's rail using the Standardized North American Marsh Bird Monitoring Protocols (Conway 2009) only provide a minimum number of Yuma Ridgway's rails present. Detections indicate presence, but do not assess absence or annual abundance. Over the 2012–2022 period, the detection numbers fluctuated between 361 and 839 (personal communication, Nichole Engelmann, Biologist, USFWS, to Jessica Gwinn, Supervisory Biologist, USFWS 2024), reaching the minimum recovery population size of over 700 (USFWS 1983) in 3 of those 11 years. The number of Yuma Ridgway's rails heard during surveys at the Cienega de Santa Clara and other sites in Mexico from 1998 through 2006 ranged from 164 to 382. The 2006 population estimate for the Cienega de Santa Clara was 5,974 and was extrapolated based on estimated acreage and does not represent a statistical estimation of the population (Hinojosa-Huerta et al. 2008).

The species is currently considered to have a high degree of threat and low recovery potential from loss of habitat due to lack of natural river processes that create and maintain marshes and lack of security relative to the protection of existing habitats in the United States and Mexico (USFWS 2010). Historically, cattail/bulrush marshes in the Colorado River Delta were likely the stronghold for the species (Rosenburg et al. 1991). The elimination of freshwater flows down the lower Colorado River to the Colorado River Delta due to diversions from the river resulted in loss of that habitat. Early naturalists on the Colorado River did not record them north of the Gila River confluence with the Colorado River before 1920 (Rosenburg et al. 1991). They were detected in the marshes north of Laguna Dam after the 1924 floodwaters receded (Rosenburg et al. 1991). The current habitats are primarily formed behind dams and

diversions on the lower Colorado River and human-made marshes and ponds including Beal Lake, Hart Mine Marsh, Imperial Ponds, the ponds at the Salton Sea, and the marshes at the Cienega de Santa Clara. The existing habitat is subject to natural successional processes that reduce habitat value over time without also being subject to natural restorative events generated by a natural hydrograph (USFWS 2010).

The Yuma Ridgway's rail is threatened by river management activities that are detrimental to marsh formation, such as dredging, channelization, bank stabilization, and other flood control measures. Another serious threat is environmental contamination caused by selenium (USFWS 2010). High selenium levels have been documented in some adult birds and eggs and in crayfish populations. Selenium, which may cause metabolic problems and affect the reproductive success of Yuma Ridgway's rails, comes primarily from the seleniferous soils of the Mancos Shale Formation carried by return flows of irrigation water and transported into the lower Colorado River. Evaporation then concentrates the selenium in the water, from which it can be deposited into river sediments, accumulate in backwater marshes, be absorbed into vegetation, and bioaccumulate in invertebrates and fish (Martinez 1994; Rosenberg et al. 1991; Rusk 1991; USFWS 2010). Lower water levels may expose contaminated sediments or prey, such as crayfish, which may contribute to bioaccumulation in the species. Many aspects of the effect of selenium on Yuma Ridgway's rail are still unknown (USFWS 2010). On the basis of analyses of selenium in tissue samples from marsh birds and invertebrates, Rusk (1991) concluded that the risk for mortality of adult birds from selenium is low and assessed the risk for the development of genetic deformities in marsh birds that use backwaters as moderate to high. Preliminary information from a joint USFWS-USGS study on selenium in Yuma Ridgway's rails at the Salton Sea and the lower Colorado River shows that concentrations in eggs were well above suggested "No Effect Concentrations" at 3.30 to 12.0 micrograms per gram (µg/g) and 15.0 µg/g in blood and 20.0 µg/g in feathers (USFWS 2010). Survey data have not shown a definitive decline in Yuma Ridgway's rail numbers over time, but the data are not robust. The numbers of birds observed varies within sites from year to year, sometimes with large declines in detections that may be the result of changes to habitat, efficiency of surveyor, and local weather conditions (USFWS 2010). Other threats to the Yuma Ridgway's rail include fires during their breeding season (Todd 1986), mosquito abatement activities, agricultural activities, development, and the displacement of native plant communities by exotic vegetation (California Department of Fish and Game 1991).

The large population of Yuma Ridgway's rails at the Cienega de Santa Clara is threatened by the loss of the source of water that maintains the wetlands. The Cienega de Santa Clara population is supported by the Wellton-Mohawk Main Outlet Drain Extension (MODE) and Riito drain waters (Glenn et al. 1996). Since 1977, the MODE has carried 4.2–6.4 × 109 cubic feet per year of mildly saline (i.e., 3 parts per thousand) groundwater from the Wellton-Mohawk Irrigation District in Arizona for disposal in the eastern delta (Burnett et al. 1993). Future water management decisions may result in the diversion of the MODE drain waters away from the Cienega de Santa Clara. Diversion of the MODE water would likely result in the elimination of dominant wetland vegetation and functions at the Cienega de Santa Clara (Burnett et al. 1993; Glenn et al. 1995; Glenn et al. 1996; Zengel et al. 1995). A large-scale conversion of wetlands would have drastic impacts on the Yuma Ridgway's rail population that inhabits the Cienega de Santa Clara.

Analysis of the Species/Critical Habitat to Likely be Affected

The analysis will include the Yuma Ridgway's rail breeding and foraging habitat in Reaches 3 through 5.

No critical habitat has been designated for the Yuma Ridgway's rail.

Environmental Baseline

STATUS OF SPECIES WITHIN THE ACTION AREA

There are no areas in Reach 2 that provide habitat for Yuma Ridgway's rail and could be affected by increased reductions in releases from Hoover Dam.

Yuma Ridgway's rails have been detected in Reaches 3, 4, and 5 (Table 3-1). Most Yuma Ridgway's rails detected in Reach 3 were in Topock Marsh and Topock Gorge, and a small population was in the marshes of the Bill Williams River Delta. In Reach 4, most Yuma Ridgway's rails were detected on Cibola NWR at Cibola Lake, Hart Mine Marsh, and the old river channel. In Reach 5, Yuma Ridgway's rails were detected in the Imperial NWR, Picacho State Recreation Area, and between Martinez Lake and Imperial Dam.

Table 3-1. Yuma Ridgway's Rails Detected in Reaches 3 through 5, 2006–2022

Year	Reach 3	Reach 4	Reach 5
2006	91	42	76
2007	110	33	32
2008	95	17	42
2009	113	34	69
2010	118	6	40
2011	133	52	42
2012	100	24	33
2013	99	31	50
2014	134	20	30
2015	163	60	116
2016	85	60	88
2017	132	72	85
2018	63*	97	78
2019	155	108	56¶
2020	5†	60	57¶
2021	114‡	67	17¶
2022	32§	42	46¶

Source: Unpublished data compiled by Nichole Engelmann, USFWS, Arizona Ecological Services from all entities reporting survey data to USFWS.

Note: Reach 3 includes Topock Marsh, Topock Gorge, Beal Lake, Willow Marsh, and the Bill Williams River NWR; Reach 4 includes Cibola NWR and Hart Mine Marsh; and Reach 5 includes Imperial Division and Imperial NWR.

* No surveys completed at the Bill Williams River NWR.

† No surveys completed at Beal Lake, the Bill Williams River NWR, or Topock Gorge.

‡ No surveys completed at Beal Lake.

§ No surveys completed at Topock Marsh or Beal Lake.

¶ No surveys completed at Imperial Division.

Regionally Significant Populations in the LCR MSCP Planning Area

Populations of Yuma Ridgway's rails are found within the LCR MSCP planning area in Reaches 3 through 6. An analysis of survey data from 1995 to 2013 showed that between 30% and 58% of the Yuma

Ridgway's rails detected in the United States were within the LCR MSCP planning area (USFWS 2005b, 2013).

- Most Yuma Ridgway's rails detected in Reach 3 were in Topock Marsh and Topock Gorge, and a small population was in the marshes of the Bill Williams River Delta.
- In Reach 4, most Yuma Ridgway's rails were detected on Cibola NWR at Cibola Lake, Hart Mine Marsh, and the old river channel.
- In Reach 5, Yuma Ridgway's rails were detected in the Imperial NWR, Picacho State Recreation Area, and between Martinez Lake and Imperial Dam.
- In Reach 6, most Yuma Ridgway's rails were detected between Imperial Dam and Laguna Dam, including Mittry Lake and Laguna Division Conservation Area. They have also been detected at Yuma East Wetlands.

On average, the Yuma Ridgway's rails detected within the LCR MSCP planning area were distributed among the reaches as follows: Reach 3: 31.6%, Reach 4: 16.8%; Reach 5: 25.3%; Reach 6: 25.7%; and Reach 7.0.6% (LCR MSCP 2016).

Management Needs, Existing Management Actions, and Recovery Goals

Reclamation (1998a) is ensuring that its operations and maintenance actions will result in no net loss of Yuma Ridgway's rail habitat in accordance with the HCP (LCR MSCP 2004a). Toward this end, Reclamation prepared a Yuma Ridgway's rail management plan for areas under its management (Reclamation 1998b). As part of the LCR MSCP, Reclamation is creating and managing 512 acres of marsh habitat for the species, while providing funding to protect and enhance existing habitat along the lower Colorado River. As part of the conservation measures incorporated into the 2022 BO (USFWS 2022), Reclamation will create and manage an additional 15 acres of marsh in Reach 3. Reclamation also ensures that all ground-disturbing activities (e.g., channel maintenance activities) avoid Yuma Ridgway's rail habitat and are not conducted near Yuma Ridgway's rail habitat during the nesting season.

Arizona Partners in Flight has designated the Yuma Ridgway's rail as a priority species for marsh areas (Latta et al. 1999). In addition, a wide variety of habitat-based management actions are ongoing throughout the lower Colorado River Basin. Most of these actions are small-scale projects that focus on the restoration/enhancement of native riparian, riverine, and marsh areas. Cumulatively, these actions have the potential to aid significantly in efforts to conserve the Yuma Ridgway's rail.

The USFWS approved the Yuma Ridgway's rail recovery plan in 1983. A draft revision was submitted for public comment in 2010, but it has not yet been finalized. The stated purpose of the recovery plan is to provide natural resource management agencies and conservation groups with background information on the Yuma Ridgway's rail and indicate new or ongoing tasks needed to achieve eventual federal and state delisting of the species (USFWS 1983).

The draft revised Yuma Ridgway's rail recovery plan (USFWS 2010) identifies several management activities necessary to reach recovery goals. These activities include the following:

1. Determine the minimum number of breeding birds in the United States that provides for a statistically and genetically secure population.
2. Provide for coordinated annual surveys of populations in core habitat areas in the United States with expansion to other habitats as appropriate.
3. Cooperate with agencies in Mexico to survey populations there.

4. Refine knowledge of physical factors that provide for suitable habitat to contribute to management actions and creation of new habitat areas.
5. Refine knowledge of habitat use to ensure protection and management of sufficient habitat to support desired U.S. population levels.
6. Determine the level of risk to Yuma Ridgway's rail from existing and potential levels of selenium in occupied habitats.
7. Identify migration pathways between the three core populations to assess metapopulation status and contribute to determinations on minimum population size and habitat necessary to support that population.
8. Ensure that existing core habitat areas and newly created habitats are protected and managed for long-term habitat suitability.
9. Through the recovery implementation team, collaborate on research and monitoring to effectively implement the plan and address issues affecting the species in Mexico.
10. Work with all potential partners to develop cooperative conservation efforts to support the implementation of the plan and recovery of the species.
11. Use adaptive management to update and revise the plan or tasks as pertinent new information becomes available.

Recovery Goal: To achieve population stability and habitat protection sufficient to downlist and/or delist the Yuma Ridgway's rail.

Recovery Objectives:

1. Documentation of a stable or increasing trend for numbers of rails in the United States as shown through annual rail surveys based on maintaining a statistically secure minimum population size determined by research and modeling (as exemplified in Fleischer et al. [1995]).
2. Protection of sufficient breeding and wintering habitat to support the desired minimum population size from identified threats and allow for connectivity of habitat.
3. Development of management plans for all important federally and State-owned habitat areas in the United States and for the Cienega de Santa Clara in Mexico that provide for habitat development, maintenance of suitable habitat conditions, and protection from human disturbances.
4. Completion of an assessment of the degree of threat from existing and predicted selenium levels to adult rails and recruitment of young rails and, if necessary, implementation of management actions to control this threat in rail habitats.
5. Evaluation of potential migration pathways between the lower Colorado River, Salton Sea, and Mexican core habitat areas that provide for connectivity that supports population viability and, if appropriate, development of management plans to protect stop-over habitats.
6. Completion of efforts to protect and secure for the long-term an adequate water supply to support rail habitat at current levels at the Salton Sea and in the Cienega de Santa Clara.

Recovery Criteria: The Yuma Ridgway's rail will be considered for downlisting when the following criteria are met:

1. Annual rail surveys document a stable or increasing trend in population based on a minimum of 824 rails in the United States for at least 5 consecutive years.

2. Management plans for all important federally and State-owned habitat areas are developed. For the lower Colorado River, these areas are: Havasu National Wildlife Refuge, Bill Williams National Wildlife Refuge, Cibola National Wildlife Refuge, Imperial National Wildlife Refuge, Mittry Lake State Wildlife Area, Imperial Division lands of the Bureau of Land Management; for the Salton Sea: Sonny Bono Salton Sea National Wildlife Refuge and Imperial State Wildlife Area.
3. Long-term contracts providing for a quality and quantity of water to support the Yuma Ridgway's rail habitats at the Salton Sea are in place. The amount and quality of the water supply should be sufficient to maintain healthy cattail marsh habitat at Sonny Bono Salton Sea NWR and Imperial Wildlife Area.
4. Annual rail surveys document a stable or increasing trend in population based on a desired population of 824 individuals (or a higher minimum population size established through research and modeling) in the United States for at least 5 years beyond that needed for downlisting.
5. The amount of habitat needed to support a minimum population size (as determined in #4 above) is established, protected, and managed to ensure adequate breeding and wintering habitat in the United States.
6. An assessment of the degree of threat from existing and predicted selenium levels to adult rails and recruitment of young rails is completed, and, if necessary, management actions to control this threat in rail habitats are implemented.
7. An evaluation is completed of potential migration pathways between the lower Colorado River, Salton Sea, and Mexican core habitat areas that provide for connectivity that supports population viability and, if appropriate, management plans are developed to protect stopover habitats.
8. A water supply of sufficient quality to assure the continuation of current levels of rail habitat, in terms of both quantity and quality has been secured for the long-term for the Cienega de Santa Clara. This water supply can be of the current quantity (approximately 100,000 afy), and quality (averaging less than 2,660 parts per million [ppm]) or that needed to maintain salinities in the Cienega below that needed for cattail growth [5,000–6,000 ppm]) over the long term.

Progress toward achieving recovery criteria will be measured via research, monitoring, and completion of management plans for core habitat areas. In addition, regulatory mechanisms and land-management commitments must be implemented to provide adequate protection of the Yuma Ridgway's rail and its habitats. These commitments and mechanisms should address habitat protection and maintenance, environmental contaminants, and public outreach.

3.3 Southwestern Willow Flycatcher (*Empidonax traillii extimus*)

3.3.1 Species Description, Life History, Population Dynamics

3.3.1.1 HABITAT

Nesting habitat for the southwestern willow flycatcher (*Empidonax traillii extimus*) typically has dense canopy cover and is generally associated with standing or slow-moving surface water or saturated soils. Occupied habitat is often dominated by shrubs and trees 10 to 30 feet tall that provide dense low and midstory vegetation, with small twigs and branches for nesting. Plant structure and the presence of surface water or saturated soils may be more important than plant species composition in defining suitable southwestern willow flycatcher habitat (*Federal Register* 60:10694–10715).

Occupied patch size and shape can vary substantially between occupied southwestern willow flycatcher nesting sites. Patch size can range from less than 1 ha (2.5 acres) to over 100 ha (250 acres). Estimated territory sizes range from 0.06 ha to 2.3 ha (Paxton et al. 2007; Sogge et al. 1997; Whitfield and Enos 1996). Although many occupied sites are small, this subspecies generally avoids nesting in narrow, linear corridors with only a few scattered trees (USFWS 2002a).

Nesting success rates for the southwestern willow flycatcher are affected by brood parasitism by the brown-headed cowbird (*Molothrus ater*). Brown-headed cowbirds usually parasitize songbird nests that are situated near forest edges (Gates and Evans 1998; Rothstein et al. 1984). Thus, southwestern willow flycatcher nests in narrow or fragmented riparian corridors tend to be more susceptible to parasitism by cowbirds than those near clearings and low-water swales in larger riparian stands (e.g., greater than 1 ha [2.5 acres]). Brown-headed cowbirds are common or abundant in many areas along the lower Colorado River. The rate of brown-headed cowbird parasitism on southwestern willow flycatcher nests along the lower Colorado River can be substantial, and parasitism reduces southwestern willow flycatcher nesting success throughout the region (McLeod et al. 2018).

3.3.1.2 BREEDING

The southwestern willow flycatcher is a riparian obligate insectivore that breeds in summer along rivers, streams, and other wetlands where dense cottonwood, willow, saltcedar, or other similarly structured riparian vegetation occurs (*Federal Register* 60:10694–10715; USFWS 2002a). Along the lower Colorado River, southwestern willow flycatchers begin nesting in May and continue into August. They nest in riparian vegetation characterized by low, dense shrubs, such as willows and saltcedar, often with a sparse to dense overstory of Fremont cottonwoods (*Populus fremontii*) or Goodding's willows (*Salix gooddingii*); surface water or moist soil is usually present beneath the canopy (McKernan and Braden 2001b). Along the lower Colorado River, saltcedar is a minor to major component in all occupied southwestern willow flycatcher habitat areas.

3.3.1.3 DIET

The southwestern willow flycatcher is an insectivore that hawks insects while in flight, gleans insects from foliage, and occasionally captures them from the ground (USFWS 2002a). The main diet of the southwestern willow flycatcher consists of small- to medium-size insects such as true bugs, wasps and bees, flies, beetles, butterflies and caterpillars, and spiders. Berries and small fruits have also been reported but are typically rare. The southwestern willow flycatcher can exploit a diverse array of insects depending on availability within the habitat between sites and between years depending on abundance and availability of insects in and near the breeding habitat (DeLay et al. 2002; Drost et al. 2003; Durst 2004).

3.3.1.4 STATUS AND DISTRIBUTION

Status

The southwestern willow flycatcher is listed as endangered under the ESA and California Endangered Species Act. Critical habitat was designated in 2013, but the action area was excluded from the critical habitat designation because of conservation provided by the LCR MSCP.

The southwestern willow flycatcher is also:

- a G5T2 (global rank),
- a Tier 1 SGCN and an S1 (state rank) in Arizona,
- an S1 (state rank) in California, and

- an S1 (state rank) in Nevada.

Distribution

Range Wide

The southwestern willow flycatcher is one of four generally recognized subspecies of the willow flycatcher (*Empidonax traillii*). Southwestern willow flycatchers are neotropical migrants that were once widespread and locally common throughout riparian areas of the arid Southwest. Their historical breeding distribution included southern California, southern Nevada, southern Utah, Arizona, New Mexico, and western Texas (Browning 1993; Hubbard 1987; Unitt 1987). The current range is similar to the historic range, although the quantity of suitable habitat is reduced from historical levels (USFWS 2022).

REASON FOR LISTING AND CURRENT THREATS

In 2012, the range-wide population was estimated at 1,629 territories (Durst 2017). Most breeding sites are small, supporting fewer than five pairs. The primary factors responsible for the decline of the southwestern willow flycatcher are the loss and degradation of native riparian vegetation, particularly cottonwood-willow associations (*Federal Register* 60:10694–10715). Related factors contributing to the decline of this subspecies include brood parasitism by brown-headed cowbirds (especially in small, fragmented riparian stands), increased nest predation on eggs and nestlings (e.g., common kingsnake [*Lampropeltis getula*], gopher snake [*Pituophis catenifer*]), saltcedar invasion, urban and agricultural development, livestock grazing, water diversion and impoundment, channelization, off-road vehicle use and recreation, floods, pesticides, forest practices, and possible gene pool limitations (*Federal Register* 60:10694–10715; USFWS 2002a). A recent contributor to the loss of southwestern willow flycatcher habitat is the tamarisk leaf beetle (*Diorhabda* spp.) (USFWS 2017).

In addition, like many other neotropical migratory birds, the southwestern willow flycatcher may be threatened by the loss and alteration of habitat on its migratory route and wintering grounds (*Federal Register* 60:10694–10715; USFWS 2002a, 2014). Approximately half of all southwestern willow flycatcher territories have a substantial saltcedar component, and tamarisk leaf beetles are a significant threat to the quality and quantity of southwestern willow flycatcher habitat (USFWS 2017). Climate change is anticipated to exacerbate existing impacts related to water management and drought (USFWS 2014).

Analysis of the Species/Critical Habitat to Likely be Affected

The analysis will include the southwestern willow flycatcher breeding habitat along the mainstem of the lower Colorado River (at Topock Marsh on Havasu NWR and the Bill Williams River Delta), and cottonwood-willow and mesquite (*Prosopis* spp.) habitat used for foraging and resting during migration.

Critical habitat was designated in 2013, but the action area was excluded from the critical habitat designation because of conservation provided by the LCR MSCP.

Environmental Baseline

STATUS OF SPECIES WITHIN THE ACTION AREA

There are no areas in Reach 2 that provide habitat for southwestern willow flycatchers. In Reach 3, southwestern willow flycatchers have been found at the Beal Lake Conservation Area, Topock Marsh, and in the delta of the Bill Williams River at Lake Havasu (Table 3-2). Breeding territories have only been detected in Reach 3 at Topock Marsh and along the Bill Williams River since 2005. Breeding at

Topock Marsh in 2021 was limited to Hell Bird, 800M, and Lost Lake Slough 03. In 2022, breeding at Topock Marsh was limited to Lost Lake Slough 03 (Figure 3-4 and Figure 3-5). The Bill Williams River Delta burned in the Planet Ranch Fire in June 2021, and the burned habitat and areas subsequently restored do not currently provide habitat for breeding southwestern willow flycatchers.

Table 3-2. Southwestern Willow Flycatchers Detected at Beal Lake Conservation Area, Topock Marsh, and the Bill Williams River Delta in Reach 3, 2006–2022

Year	Beal Lake Conservation Area	Topock Marsh	Bill Williams River Delta	Total
2006	0	30	0	**30**
2007	0	18	0	**18**
2008	0	20	0	**20**
2009	1	15	0	**16**
2010	0	13	2	**15**
2011	0	5	0	**5**
2012	1	2	3	**6**
2013	1	9	0	**10**
2014	1	8	4	**13**
2015	0	15	7	**22**
2016	1	9	12	**22**
2017	0	4	10	**14**
2018	0	4	1	**5**
2019	0	12	1	**13**
2020	0	10	0	**10**
2021	0	5	0	**5**
2022	0	3	NS	**3**

Sources: McLeod and Pellegrini (2013), McLeod et al. (2018), McLeod et al. (2022).

Note: NS = no surveys were conducted because the area was consumed in the Planet Ranch Fire in June 2021. Survey sites included in the Bill Williams River Delta are Coyote Crossing, Wispy Willow, Bill Willow, Site 01, Site 02, and Burn Edge.

Southwestern willow flycatcher habitat in Reach 3 has been affected by water management, fire, and tamarisk leaf beetles. Water levels at Topock Marsh were lowered in 2010 and 2011 to allow construction of a new water delivery canal. Several southwestern willow flycatcher breeding sites at Topock Marsh were consumed in the Willow Fire in August 2015, and tamarisk leaf beetles defoliated saltcedar at Topock Marsh starting in the middle of the southwestern willow flycatcher breeding season in 2017. A portion of the Bill Williams River Delta was consumed in a fire in 2006, and the entire area burned in the Planet Ranch Fire in 2021. Tamarisk leaf beetles defoliated saltcedar in the Bill Williams River Delta starting at the beginning of the southwestern willow flycatcher breeding season in 2017.

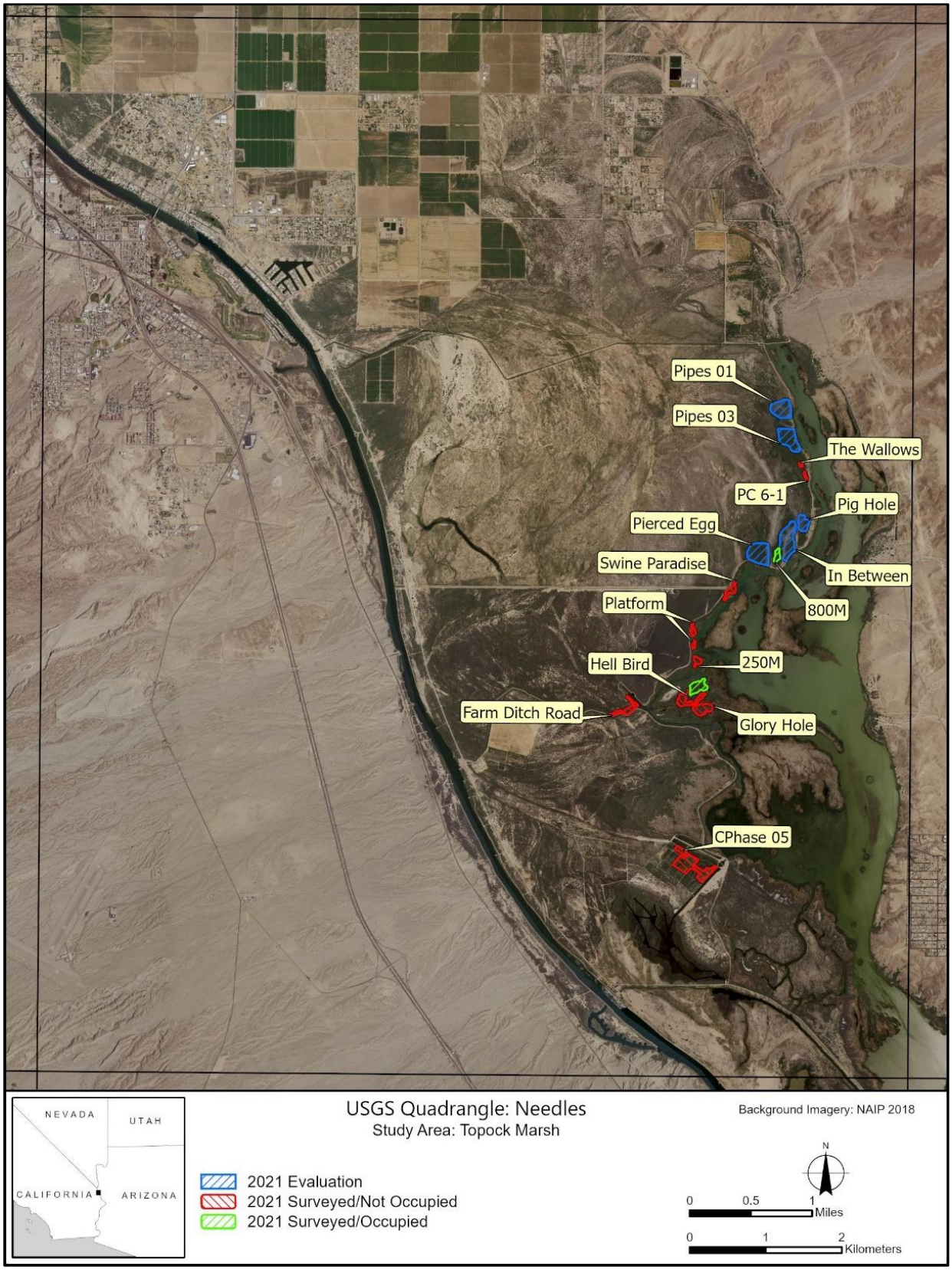


Figure 3-4. Recent southwestern willow flycatcher survey areas at Topock Marsh on Havasu NWR (McLeod and Pellegrini 2022).

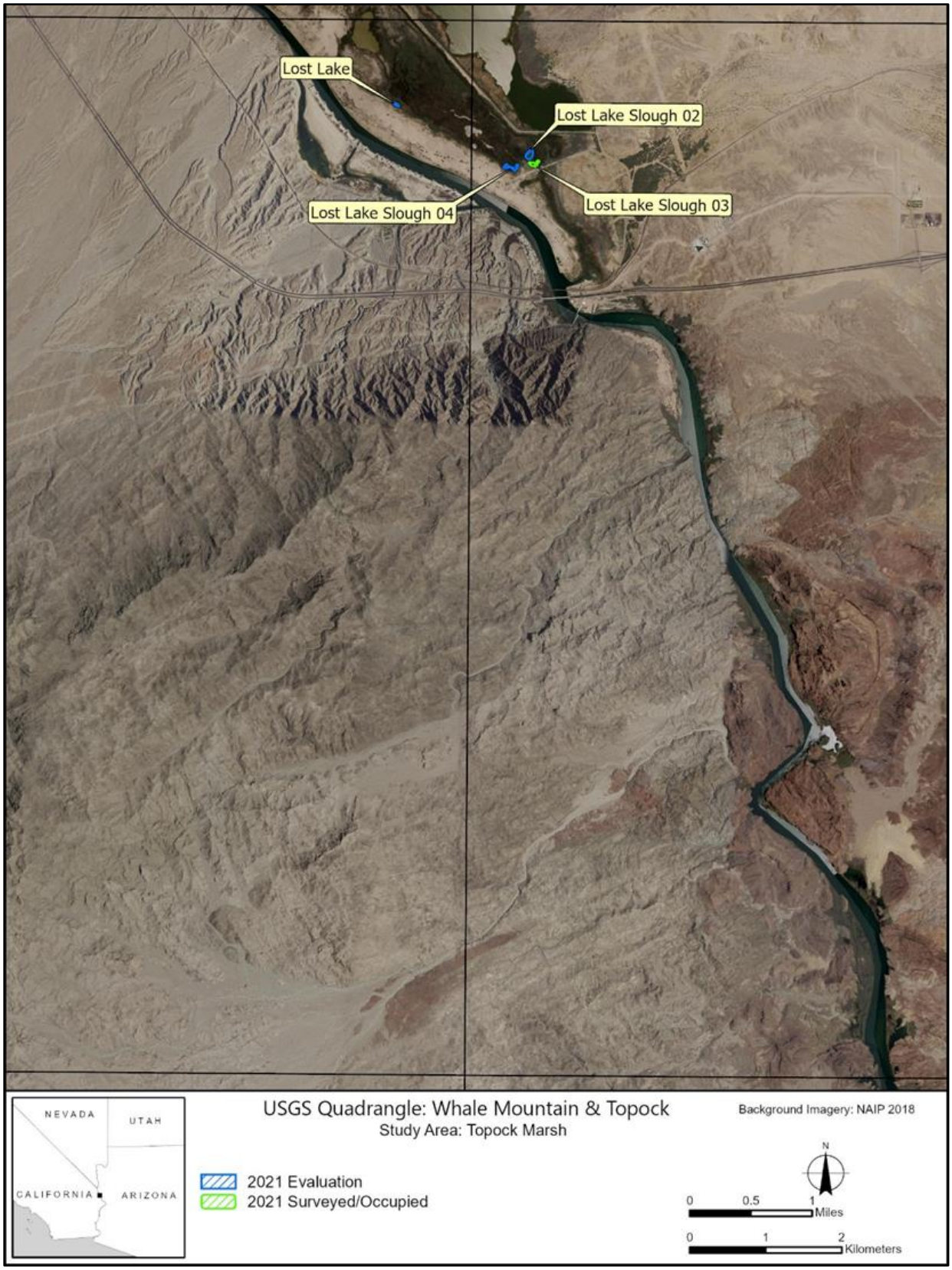


Figure 3-5. Recent southwestern willow flycatcher survey areas at the southern end of Topock Marsh on Havasu NWR (McLeod and Pellegrini 2022).

A linear regression of the number of resident southwestern willow flycatchers detected at the Topock Marsh and Bill Williams River study areas, combined, from 1998 through 2017 indicated a declining population, with an annual rate of population change of −5.6%. Demographic analyses over the same period indicated that the southwestern willow flycatcher population at the Topock Marsh and Bill Williams study areas was sustained by immigration (McLeod et al. 2018).

No breeding southwestern willow flycatchers have been documented in Reaches 4 and 5 since the LCR MSCP was implemented in 2005. Southwestern willow flycatcher surveys have been conducted annually at numerous sites, and only five willow flycatchers that exhibited territorial behaviors (i.e., insistent, spontaneous song) have been detected: the period of detection ranged from a single occasion to 2 weeks. All but one of these detections were within LCR MSCP conservation areas (McLeod and Pellegrini 2013; McLeod et al. 2018; McLeod et al. 2022). Numerous migratory willow flycatchers are documented each year in Reaches 4 and 5. Colorimetry analysis of migrant willow flycatchers captured in Reaches 5 through 7 indicated that over half of the individuals captured were of the southwestern subspecies, suggesting that the lower Colorado River provides important stopover sites (Paxton et al. 2010).

Regionally Significant Populations in the LCR MSCP Planning Area

Until surveys discovered breeding southwestern willow flycatchers at Topock Marsh in 1996, the southwestern willow flycatcher was thought to be extirpated as a breeding species along the lower reaches of the Colorado River. Topock Marsh has been occupied annually since 1996 (Braden and McKernan 2006; McLeod and Pellegrini 2013; McLeod et al. 2018; McLeod et al. 2022). Southwestern willow flycatchers also occupied the Bill Williams River Delta at Lake Havasu in 2012 and 2014–2019. Southwestern willow flycatchers were also documented nesting in the Colorado River Delta at Lake Mead nearly annually from 1995 through 2006, when water levels in Lake Mead favored the development of dense riparian vegetation.

Critical Habitat

Critical habitat was designated in 2013, but the action area was excluded from the critical habitat designation because of conservation provided by the LCR MSCP.

Management Needs, Existing Management Actions, Recovery Goals

Management needs for the southwestern willow flycatcher include protecting areas that currently provide southwestern willow flycatcher breeding habitat and preserving natural ecological processes that allow riparian habitats to establish and develop. In areas where those processes are compromised, active human manipulation is needed to promote and create new riparian habitats. Active management is most critically needed in areas where tamarisk leaf beetles have degraded or are likely to degrade southwestern willow flycatcher breeding habitat.

Existing management actions include Reclamation completing annual surveys and monitoring for southwestern willow flycatchers along the lower Colorado River and the Middle Rio Grande. Southwestern willow flycatcher surveys and monitoring are also completed regularly or irregularly by a variety of entities in several other locations, including southern Nevada (Pahranagat Valley, Virgin and Muddy Rivers), southern Utah (Virgin River), southern California (San Luis Rey River, Kern River), and central and eastern Arizona (Roosevelt Lake, Gila River). Habitat creation or enhancement targeted at southwestern willow flycatchers has been undertaken along the lower Colorado River as part of the LCR MSCP, on the Virgin River in Utah and Nevada, at Roosevelt Lake, and along the Gila River in eastern Arizona.

The primary recovery goal for the southwestern willow flycatcher is delisting through recovery (USFWS 2002a). Delisting may be considered when criteria from either of the following two sets are met. These criteria will be reevaluated at 5-year intervals and modified if warranted by new scientific information.

Criteria Set A

The objectives include:

- each management unit (Middle Colorado, Virgin, Hoover-Parker, and Parker-Southerly International Boundary) within the Lower Colorado Recovery Unit must meet and hold 80% of its minimum population targets (25, 100, 50, and 150, respectively);
- the Lower Colorado Recovery Unit must meet its recovery goal of a minimum of 525 territories; and
- the range-wide goal must be met with a minimum overall population size of at least 1,950 territories (3,900 adults), geographically distributed to form metapopulations that safeguard against extinction that must be maintained over a 5-year period.

Criteria Set B

The objectives include:

- each management unit must meet and hold at least 50% of its minimum population target;
- the Lower Colorado Recovery Unit must meet and hold at least 75% of its population goal;
- the range-wide goal must be met with a minimum overall population size of at least 1,500 territories (approximately 3,000 adults) geographically distributed to form metapopulations that safeguard against extinction that must be maintained over a 5-year period;
- these habitats supporting flycatchers must be provided sufficient protection over time through the development and implementation of conservation management agreements;
- these management agreements must minimize major stressors to the flycatcher and its habitat, ensure that natural ecological and anthropogenic processes develop and maintain suitable habitat, and the amount of suitable habitat available within each management unit is at least double the amount required to support their minimum population targets; and
- the USFWS must be satisfied that those agreements provide adequate protection and/or enhancement of habitat.

3.4 Western Yellow-Billed Cuckoo (*Coccyzus americanus occidentalis*)

3.4.1 Species Description, Life History, Population Dynamics

3.4.1.1 HABITAT

The western yellow-billed cuckoo (*Coccyzus americanus occidentalis*) nests in blocks of riparian woodland that are usually 20 ha (50 acres) or larger (Halterman et al. 2016; *Federal Register* 78:61622–61666). Occupied lowland riparian habitat generally consists of mature willow and cottonwood forest, although other riparian tree species such as mesquite and saltcedar may also be present. Reported home

range sizes vary from 22 ha (54 acres) to 82 ha (204 acres) (McNeil et al. 2011; *Federal Register* 78:61622–61666).

3.4.1.2 BREEDING

Western yellow-billed cuckoos are late spring migrants. Some individuals can arrive in mid- to late May, but most do not arrive until mid-June. Pair formation occurs from late June to mid-July (Halterman 1991). Nesting generally peaks during July and early August and can continue into September. Both parents participate in the placement and building of the nest as well as incubation and feeding of young (Halterman 1991; Hughes 2020). Western yellow-billed cuckoos may double or even triple brood if sufficient resources exist (McNeil et al. 2013). Nests consist of a loose platform of sticks. In the LCR MSCP study area, the average clutch size was 2.8 from 72 nests monitored between 2008 and 2012 (McNeil et al. 2013). Fall migration begins in August, and most birds leave by mid-September (McNeil et al. 2013).

3.4.1.3 DIET

Large prey items such as cicadas, katydids, grasshoppers, and caterpillars form the bulk of the western yellow-billed cuckoo's diet (*Federal Register* 78:61622–61666), and arrival on the breeding grounds may be timed to coincide with abundant prey. Population levels and breeding timing may be tied to the abundance of prey items (Halterman et al. 2016; *Federal Register* 78:61622–61666).

3.4.1.4 STATUS AND DISTRIBUTION

Status

The western distinct population segment of the yellow-billed cuckoo is listed as threatened under the ESA. Critical habitat was designated in 2021, but the action area was excluded from the critical habitat designation because of conservation provided by the LCR MSCP.

The western distinct population segment of the yellow-billed cuckoo is also:

- a G5 (global rank),
- a Tier 1 SGCN and an S3 (state rank) in Arizona,
- an S1 (state rank) in California, and
- an S1 (state rank) in Nevada.

Distribution

Range Wide

Historically, the western yellow-billed cuckoo was a fairly common breeding species throughout the river bottoms of the western United States and southern British Columbia (Gaines and Laymon 1984). As a result of the loss of riparian woodland, the western yellow-billed cuckoo has become an uncommon to rare summer resident in scattered locations throughout its former range.

REASONS FOR LISTING AND CURRENT THREATS

Western yellow-billed cuckoos were fairly common and widespread in riparian systems throughout the western United States up until the early 1900s. Since then, this species has decreased substantially in abundance. Surveys conducted in California during 1986 and 1987 found 31 to 42 breeding pairs along

the upper Sacramento River, the Feather River, the south fork of the Kern River, and along the Santa Ana, Amargosa, and lower Colorado Rivers (California Department of Fish and Game 1991). This represents a 66%–81% decline from 1977 surveys, when there were an estimated 122 to 163 pairs.

Along the lower Colorado River, there was an estimated 93% decline in western yellow-billed cuckoos between 1976, when surveys documented 242 individuals, and 1986, when the population was estimated at 18 individuals based on loss of previously occupied habitat (Rosenberg et al. 1991).. Gaines and Laymon (1984) documented about 65 pairs of western yellow-billed cuckoos along the lower Colorado River in 1977, when more than 4,000 ha (10,000 acres) of suitable nesting habitat still existed there (Hunter et al. 1987). The number of western yellow-billed cuckoos present along the lower Colorado River increased from the mid-2000s until 2016, when there was an estimated maximum of 124 territories, and then declined through 2022, when there was an estimated maximum of 46 territories (Halterman et al. 2009; McNeil et al. 2013; McNeil and Tracy 2013; Parametrix and Southern Sierra Research 2019; Tracy et al. 2023). The increase and decrease of the western yellow-billed cuckoo population over the last two decades was driven by the growth and then advancing age of conservation areas along the lower Colorado River.

At the Bill Williams River Delta, western yellow-billed cuckoos decreased about 75% between the mid-1970s and 1986, with only 50 to 60 western yellow-billed cuckoos remaining in 1986. This population fluctuated but continued to decline during the 1990s: 1993 (22–29 pairs), 1994 (26–32 pairs), 1997 (12–15 pairs), 1998 (20–25 pairs), 1999 (6–9 pairs), and 2000 (10–13 pairs) (Halterman 2001). The population at the Bill Williams River Delta continued to decline, and in 2015, only one possible territory was detected (Parametrix and Southern Sierra Research Station 2016). Surveys have been limited since 2015, and detections remain low.

The decline of the western yellow-billed cuckoo is primarily the result of the loss and degradation of riparian habitat (*Federal Register* 78:61622–61666). Riparian habitats have been affected by dams, water diversions, channelization, conversion of floodplains to agriculture, and the conversion of native habitats to monotypic stands of nonnative vegetation such as saltcedar.

For western yellow-billed cuckoo breeding habitat to remain suitable, or for additional areas to develop into suitable habitat, the process of native vegetation recruitment and maturity must be maintained (*Federal Register* 78:61622–61666). This process is interrupted by anthropogenic changes to hydrology as the result of dams, diversions, and channelization. Other current threats include the loss of riparian habitats from fire, agricultural conversion, the spread of nonnative vegetation, drought, and climate change.

Analysis of the Species/Critical Habitat to Likely be Affected

The analysis will include the western yellow-billed cuckoo breeding habitat along the mainstem of the lower Colorado River and cottonwood-willow habitat used for foraging and resting during migration.

Critical habitat was designated in 2021, but the action area was excluded from the critical habitat designation because of conservation provided by the LCR MSCP.

Environmental Baseline

STATUS OF SPECIES WITHIN THE ACTION AREA

There are no areas in Reach 2 that provide habitat for western yellow-billed cuckoos. Reach 2 is characterized by the steep wall of Pyramid, El Dorado, and Black Canyons for most of its length and due to the topography of the canyons, does not support western yellow-billed cuckoo habitat. The rest of

Reach 2 is occupied by Lake Mohave; the shoreline of Lake Mohave is characterized primarily by non-native (saltcedar) woody riparian vegetation (LCR MSCP 2004b; see Section 4.3.2). This is likely due to water management activities (LCR MSCP 2004b; see Section 4.2.2). In Reach 3, western yellow-billed cuckoo surveys were completed at Topock Marsh, the Beal Lake Conservation Area, and the Bill Williams River Delta. Surveys were also completed in other portions of the Bill Williams River NWR and at the Planet Ranch Conservation Area, but these locations are outside the action area. The annual estimated maximum number of western yellow-billed cuckoo territories never exceeded two at Beal Lake Conservation Area in 2008–2022 and three at Topock Marsh in 2008–2015 (Table 3-3). The annual estimated maximum number of western yellow-billed cuckoo territories in the Bill Williams River Delta generally declined from five to two in 2008–2011, to less than two in 2012–2015. Surveys at Topock Marsh and the Bill Williams River Delta ceased after 2015.

Table 3-3. Estimated Maximum Number of Western Yellow-Billed Cuckoo Territories Detected within the Action Area in Reach 3, 2008–2022

Year	Beal Lake Conservation Area	Topock Marsh	Bill Williams River Delta	Total
2008	1	1	5	**7**
2009	1	0	4	**5**
2010	1	3	2	**6**
2011	1	2	2	**5**
2012	1	1	1	**3**
2013	2	1	0	**3**
2014	1	1	0	**2**
2015	2	2	1	**5**
2016	1	NS	NS	**1**
2017	1	NS	NS	**1**
2018	1	NS	NS	**1**
2019	1	NS	NS	**1**
2020	1	NS	NS	**1**
2021	1	NS	NS	**1**
2022	1	NS	NS	**1**

Sources: Anderson et al. (2022); Halterman et al. (2009); McNeil and Tracy (2013); McNeil et al. (2013); Parametrix and Southern Sierra Research Station (2015, 2016, 2019); Tracy et al. (2023).

Note: NS = No survey. Survey sites included in the Bill Williams River Delta are North Burn, BW Marsh, and Middle Delta.

In Reach 4, western yellow-billed cuckoo surveys were completed at three conservation areas: the Palo Verde Ecological Reserve, the Cibola Valley Conservation Area, and the Cibola NWR Unit #1. Surveys were also completed at restoration sites at the ‘Ahakhav Tribal Preserve. Little suitable western yellow-billed cuckoo habitat is present in Reach 5 due to the lack of large patches of suitable habitat needed to support the documented home range of this species. Surveys were completed at a few sites that are not LCR MSCP restoration sites at Imperial NWR and Picacho State Recreation Area. The annual estimated maximum number of western yellow-billed cuckoo territories in Reaches 4 and 5 increased from seven in 2008 to 124 in 2016, and then declined to 46 in 2022 (Table 3-4). The increase and subsequent decrease were largely driven by the estimated maximum number of western yellow-billed cuckoo territories at the Palo Verde Ecological Reserve, where territory numbers increased from one in 2008 to 104 in 2016, and then declined to 23 in 2022. Territory numbers at Cibola NWR Unit #1 increased from two in 2008 to

17 or 18 each year in 2020–2022. The estimated number of territories in the Cibola Valley Conservation Area fluctuated between two and 14 territories without any obvious trend.

Table 3-4. Estimated Maximum Number of Western Yellow-Billed Cuckoo Territories Detected in Reaches 4 and 5, 2008–2022

Year	Palo Verde Ecological Reserve	Cibola Valley Conservation Area	Cibola NWR Unit #1	'Ahakhav Tribal Preserve	Reach 5	Total
2008	1	2	2	1	1	**7**
2009	2	4	2	2	1	**11**
2010	5	7	4	NS	2	**18**
2011	17	13	3	2	3	**38**
2012	39	5	7	2	2	**55**
2013	34	8	5	1	0	**48**
2014	78	3	7	1	0	**89**
2015	80	5	8	0	0	**93**
2016	104	6	14	NS	NS	**124**
2017	49	3	9	NS	NS	**61**
2018	51	5	9	NS	NS	**65**
2019	32	14	15	NS	NS	**61**
2020	39	9	18	NS	NS	**66**
2021	27	5	18	NS	NS	**50**
2022	23	6	17	NS	NS	**46**

Sources: Halterman et al. (2009); McNeil and Tracy (2013); McNeil et al. (2013); Parametrix and Southern Sierra Research Station (2015, 2016, 2019); Tracy et al. (2023).

Note: NS = No survey.

Regionally Significant Populations in the LCR MSCP Planning Area

Along the lower Colorado River, the loss of cottonwood-willow forests caused dramatic declines in the number of western yellow-billed cuckoos between the mid-1970s and the mid-1980s (*Federal Register* 78:61622–61666). In recent years, LCR MSCP conservation areas have supported breeding western yellow-billed cuckoos. The maximum estimated number of western yellow-billed cuckoo territories along the lower Colorado River peaked in 2016 at almost 130 territories (Parametrix and Southern Sierra Research Station 2019).

Management Needs, Existing Management Actions, and Recovery Goals

Management needs for the western yellow-billed cuckoo include protecting areas that currently provide western yellow-billed cuckoo breeding habitat and preserving natural ecological processes that allow riparian habitats to establish and develop. In areas where those processes are compromised, active human manipulation is needed to promote and create new riparian habitats.

Existing management actions include annual western yellow-billed cuckoo surveys on the lower Colorado River and Middle Rio Grande. In 2022, a range-wide survey effort was completed (Beauregard 2023).

Habitat creation or enhancement targeted at western yellow-billed cuckoos has been undertaken along the lower Colorado River as part of the LCR MSCP.

3.5 Humpback Chub (*Gila cypha*)

3.5.1 Species Description, Life History, Population Dynamics

3.5.1.1 HABITAT

Habitat requirements of the humpback chub (*Gila cypha*) are described in the *Species Status Assessment Report for the Humpback Chub* (*Gila cypha*) (USFWS 2018b) and are summarized as follows:

The humpback chub usually occupies diverse rocky canyon river habitat that includes substrates of boulder, cobble, talus, and gravel. The larvae, age-0, and juveniles occupy sheltered shoreline habitats with rocky substrates of boulder, cobble, and gravel with clean interstitial spaces. Age-0 and juvenile humpback chub have been associated with shoreline vegetation and juveniles are associated with pools with larger substrate present. Turbid water may also be an important habitat component for humpback chub of smaller size classes. Adults occupy deep shorelines and offshore habitats, including large recirculating eddies and pools.

Larvae and age-0 fish prefer water temperatures from 12 to 22 degrees Celsius (ºC) (optimal 16–22ºC) and they are susceptible to cold shock. Juveniles, subadults, and adults require water temperatures from 12ºC to 27ºC (optimal 16–22ºC) for growth. Water temperatures from 12ºC to 18ºC result in slower growth but greater longevity.

Special considerations for the humpback chub include adequate flows and flow range to maintain diverse habitats in rocky canyon areas, and low levels of nonnative predators and competitors.

3.5.1.2 BREEDING

In the Upper Basin, spawning occurs during or following spring runoff, and usually in April through July (Valdez and Clemmer 1982). In the Little Colorado River, adults have been documented spawning in March through May (Gorman and Stone 1999). Spawning occurs over mixed substrates, e.g., boulder, cobble, and clean gravel, at water temperatures from 14ºC to 24ºC and at a wide flow range.

3.5.1.3 DIET

An adequate and reliable food supply is necessary for larvae that begin feeding at the mesolarval and metalarval phases on diatoms, algae, and small invertebrates (e.g., rotifers, cladocerans, and copepods). Age-0 fish eat small food items such diatoms, algae, and small invertebrates (e.g., rotifers, cladocerans, copepods), and aquatic insects (midges and blackflies), and juveniles, subadults, and adults consume a variety of foods, including aquatic insects (midges and blackflies), crustaceans, plants, seeds, and terrestrial insects and reptiles delivered by flood events. Adults eat fish and may cannibalize their young.

3.5.1.4 STATUS AND DISTRIBUTION

Status

The humpback chub was listed as endangered in 1973 (*Federal Register* 39:1175) with critical habitat designated March 21, 1994 (*Federal Register* 59:13374), including about 164 miles of the Colorado River in Grand Canyon from Nautaloid Canyon (approximately 50 miles downstream of Glen Canyon Dam

[DGCD]) to Granite Park (approximately 214 miles DGCD). Granite Park is about 31 miles upstream of Separation Canyon which is the full pool elevation of Lake Mead. The *Humpback Chub Recovery Plan* was approved in 1990 (USFWS 1990) and was amended and supplemented by the 2002 *Humpback Chub Recovery Goals* (USFWS 2002b). The recovery goals included site-specific management tasks for the Lower Colorado River Basin that included the following: adequate habitat, protection from take, protection from disease, adequate regulatory mechanisms, and protections from human-made or natural factors. The most recent species status assessment was completed in 2018 and provided information supporting reclassification of the humpback chub from endangered to threatened. The humpback chub was reclassified from endangered to threatened on October 18, 2021 (*Federal Register* 86:57588).

The status of the humpback chub is described in the *Species Status Assessment Report for the Humpback Chub* (*Gila cypha*) (USFWS 2018b) and is summarized as follows:

The species status assessment considers that of eight resource categories, seven are neutral to good for the humpback chub in the Grand Canyon population. The only resource condition that is poor is an adequate and reliable food supply, which has been negatively affected by the operation of Glen Canyon Dam (USFWS 2018b).

Distribution

Range Wide

Humpback chub distribution includes populations in both the Upper and Lower Colorado River Basins. The four populations in the Upper Colorado River Basin (Black Rocks, Westwater Canyon, Desolation/Gray canyons, and Cataract Canyon) have all declined in the last 30 years but have recently stabilized at low numbers. The Dinosaur National Monument population is currently below detection limits and is now considered functionally extirpated, with the last capture occurring in 2004. A reintroduction program has been initiated by the Upper Colorado River Recovery Program to reintroduce humpback chub into the Green and Yampa Rivers in Dinosaur National Monument (Valdez et al. 2021).

The only population in the Lower Colorado River Basin is in the Grand Canyon. The Grand Canyon population has a large core of 11,500 to 12,000 adults in the Little Colorado River that has likely remained relatively stable since 2008. Earlier estimates documented a substantial decline around the 1990s, followed by a strong increase in the 2000s. The number of adults in the Little Colorado River core population decreased from 10,946 in 1989 to 5,021 in 2001, and then increased to 7,650 in 2008. Recent research suggests that these estimates are biased low by 20% to 30% because models did not include skip-spawning life history trait. In addition to the core population in and near the Little Colorado River, there are approximately 250 adults and several hundred juveniles and subadults distributed in approximately 250 miles of the mainstem, with reproduction occurring in the western Grand Canyon in more recent years. Successful translocation efforts in the Little Colorado River and Havasu Creek have expanded the range of the species into new habitats. Furthermore, spawning has also been documented with translocated fish in Havasu Creek.

Starting in 2011, humpback chub were captured in increasing numbers downstream of Separation Canyon (Rogowski et al. 2018). These fish are apparently an expansion of the population farther upstream in the Grand Canyon. All sizes and ages of fish were present in this area starting in 2016, suggesting that this may be a self-sustaining population. These fish occupy a reach of about 40 miles from Separation Canyon to Pearce Ferry where the Colorado River has carved a river channel in the deltaic deposits at the inflow of Lake Mead. Recent studies estimate approximately 24,000 adult humpback chub between Diamond Creek (approximately 226 miles DGCD) and Pearce Ferry (approximately 280 river miles DGCD) but note decreasing densities downstream of Separation Canyon (approximately 240 miles DGCD) (Van

Haverbeke et al. 2022). From 2016 through 2022, Fonken et al. (2023) captured 2,248 unique humpback chub from Diamond Creek downstream to Pearce Ferry. The majority of these fish displayed upstream movement, but recaptures generally occurred near the original capture location.

Approximately 0.5 mile downstream of Pearce Ferry is the Pearce Ferry Rapid. Relatively few humpback chub (< 30) have been captured or contacted downstream of the rapid each year since 2017 (Kegerries et al. 2017, 2018, 2019, 2021; Rogers et al. 2021, 2022). No upstream movement of marked native and nonnative fish species, including humpback chub, was detected from November 2020 through December 2022 (Fonken et al. 2023), when Lake Mead end-of-month elevations ranged from approximately 1,041 to 1,087 feet (Reclamation 2023). This suggests that the Pearce Ferry Rapid is a barrier to upstream fish movement at lower lake elevations, which benefits humpback chub upstream of the rapid by preventing upstream movement of nonnative piscivorous fishes from Lake Mead to the western Grand Canyon.

REASONS FOR LISTING AND CURRENT THREATS

The decline of the humpback chub may be due to a combination of factors, including streamflow regulation and habitat modification (including cold-water dam releases and habitat loss), competition with and predation by nonnative fish species, parasitism, hybridization with other native Gila chub species, and pesticides and pollutants (USFWS 2002b). Cold-water dam releases from Glen Canyon Dam have been somewhat ameliorated by declining levels of Lake Powell, and expansion of riverine habitat in the former Lake Mead inflow has extended habitat for the species by about 40 miles.

The current threats to survival are the same as the factors that contributed to the decline of the species. Streamflow regulation continues to affect all populations of humpback chub. Habitat modification has not been a significant threat since the humpback chub inhabits primarily rocky canyon areas. Competition and predation from nonnative fish species continues with expansion of predators, such as the smallmouth bass (*Micropterus dolomieu*) that has recently entered the Colorado River through Grand Canyon. The level of parasitism by Asian tapeworm (*Schyzocotyle acheilognathi*) and anchor worm (*Lernaea cyprinacea*) may increase with increased water temperatures from declining lake elevations. In the Lower Colorado River Basin, hybridization with roundtail chub (*Gila robusta*) or bonytail (*Gila elegans*) is not a major threat, as these species do not occur sympatrically.

Analysis of the Species/Critical Habitat to Likely be Affected

The analysis will include humpback chub and associated habitat from Separation Canyon downstream to Lake Mead.

There is no critical habitat designated for humpback chub within the action area.

Environmental Baseline

STATUS OF SPECIES WITHIN THE ACTION AREA

Reach 1

The population in Grand Canyon after Glen Canyon Dam was completed in the early 1960s was found primarily in and around the Little Colorado River, a tributary about 75 miles DGCD. In the 1990s, Valdez and Ryel (1995) described the life history and ecology of the species in Grand Canyon and reported an additional eight mainstem aggregations of fish associated with warm springs and tributary inflows, from about 45 to 228 miles DGCD. No aggregations were found downstream of Pumpkin Spring (approximately 228 miles DGCD), and only one humpback chub was captured below Diamond Creek

near Maxon Canyon (approximately 268 miles DGCD) (Valdez 1994), when Lake Mead extended to nearly full pool at Separation Canyon (approximately 255 miles DGCD).

The population of humpback chub has recently expanded downstream into what is referred to as western Grand Canyon (i.e., Havasu Rapid to Pearce Ferry, approximately 172–295 miles DGCD). Based on analyses performed for previous consultations, it was estimated that up to 62 miles of transitory Colorado River channel could form within the full-pool elevation of Lake Mead (downstream of Separation Canyon) and be occupied by humpback chub if the reservoir reached a minimum analyzed elevation of 950 feet (LCR MSCP 2004b; USFWS 2005a). With the general decline in lake level since 2005, and the extension of riverine habitat below Separation Canyon, multiple humpback chub began to be captured annually within the action area starting in 2011. In 2016, all sizes and ages of humpback chub were being captured from Diamond Creek to Pearce Ferry (approximately 54 miles), but no formal estimates of abundance were provided (Rogowski et al. 2018). Recent studies estimate approximately 24,000 adult humpback chub between Diamond Creek (approximately 226 miles DGCD) and Pearce Ferry (approximately 280 miles DGCD), but note decreasing densities downstream of Separation Canyon (approximately 240 miles DGCD) (Van Haverbeke et al. 2022). From 2016 through 2022, Fonken et al. (2023) captured 2,248 unique humpback chub from Diamond Creek downstream to Pearce Ferry. The majority of these fish displayed upstream movement, but recaptures generally occurred near the original capture location.

Approximately 0.5 mile downstream of Pearce Ferry is the Pearce Ferry Rapid. Relatively few humpback chub (< 30) have been captured or contacted downstream of the rapid each year since 2017 (Fonken et al. 2023; Kegerries et al. 2017, 2018, 2019, 2021; Rogers et al. 2021, 2022). No upstream movement of marked native and nonnative fish species, including humpback chub, was detected from November 2020 through December 2022 (Fonken et al. 2023), when Lake Mead end-of-month elevations ranged from approximately 1,041 to 1,087 feet (Reclamation 2023). This suggests that the Pearce Ferry Rapid is a barrier to upstream fish movement at lower lake elevations, which benefits humpback chub upstream of the rapid by preventing upstream movement of nonnative piscivorous fishes from Lake Mead to the western Grand Canyon.

3.6 Bonytail (*Gila elegans*)

3.6.1 Species Description, Life History, Population Dynamics

3.6.1.1 HABITAT

Very little is known about the bonytail life history and habitat requirements because of the scarcity of this species in natural environments. Prior to major introductions of nonnative species and closure of Hoover Dam in 1932, the bonytail was historically the most abundant fish species in the main river channels of the entire Colorado River system (USFWS 2002c). Preferred habitats for bonytail include "modest mid-channel currents of sandy, valley, and flat water reaches" (Pacey and Marsh 1998). Vanicek (1967) found that bonytail adults in Upper Basin riverine environments occupy pools and eddies away from strong currents. Bestgen et al. (2008) also observed or captured bonytail in pools and eddies 1 to 3 meters deep; however, they were also documented in backwaters and swift riffles. Badame and Hudson (2003) documented small bonytail using tributary mouths and larger bonytail using a variety of habitats including shoreline areas, riffles, runs, and eddies.

In the Lower Basin, bonytail populations are limited to artificial impoundments, including ponds and reservoirs. In reservoirs, bonytail are mostly pelagic, except during spawning events when they move to shallow rocky areas (Pacey and Marsh 1998). Within reservoirs, bonytail reputedly occur in lacustrine

environments rather than riverine environments. Telemetry studies in Cibola High Levee Pond revealed that adult bonytail prefer interstitial spaces associated with shoreline riprap during daylight hours, whereas open-water areas are more commonly used during nighttime hours (Marsh, Mueller, and Schwemm 2013; Mueller 2006). Intensive telemetric surveillance suggests a high degree of site-specific habitat fidelity, with individually marked bonytail consistently returning each morning to the same zone, often to the exact cavity formed within the riprap-type shoreline (Marsh, Mueller, and Schwemm 2013). These areas may simulate the boulder fields of many of the Upper Basin canyon areas where bonytail were once common.

Native Colorado River fishes may be at an advantage in swift and sometimes turbulent waters (Minckley 1973). Pimentel and Bulkley (1983) found that juvenile bonytail preferred concentrations of total dissolved solids (TDS) that range from 4,100 to 4,700 milligrams per liter (mg/L) and avoided concentrations less than 560 mg/L or greater than 6,600 mg/L. Preference for high TDS concentrations may decrease as fish get larger, and it may also suggest a habitat preference for warm, shallow backwaters where TDS concentrations are higher because of evaporation losses (Pimentel and Bulkley 1983). Bonytail preference for high TDS concentrations may have been a strategy to avoid predation by Colorado pikeminnow (Pimentel and Bulkley 1983).

3.6.1.2 BREEDING

Bonytail have been documented to spawn over gravel substrates near shore and were found in water up to 30 feet deep in reservoir environments (Jonez and Sumner 1954). Documentation of successful, natural reproduction in Cibola High Levee Pond also suggests that the species selects shoreline-associated, small cobble substrate in water less than 1 meter deep for spawning activities (Mueller et al. 2005). Bonytail spawning has never been observed in a riverine environment, but collections of ripe fish from Dinosaur National Monument indicate spawning occurred during late June and early July in the Upper Basin. Mueller (2006) reported spawning in March and April in Cibola High Levee Pond, in early May in Lake Mohave, and as late as early June in the upper Green River; the commonality of these dates appears to be water temperatures ranging from 18 to 20°C.

Under controlled conditions in hatcheries, optimum temperatures for reproduction range from 20ºC to 21ºC. Vanicek and Kramer (1969) determined that spawning occurred when temperatures reached 18ºC (mid-June to early July) in the Green River, and Marsh (1985) documented that hatching success was greatest in water temperature ranging from 15ºC to 20ºC. Bulkley et al. (1981) estimated the final thermal preferendum (i.e., optimum temperature for most physiological functions) of bonytail during their first year of life (25–50 millimeters [mm]) to be 24.2ºC.

3.6.1.3 DIET

The bonytail's diet consists of a wide variety of aquatic and terrestrial insects, worms, algae, plankton, and plant debris (Marsh, Mueller, and Schooley 2013; Mueller and Marsh 2002; Pacey and Marsh 1998). Bonytail larger than 7.9 inches collected from the Green River had consumed terrestrial insects, plant debris, and filamentous algae (Vanicek and Kramer 1969). More quantitative descriptions of the bonytail's diet preferences are not available, including shifts in diet composition by life stage, except for information from bonytail stocked into Cibola High Levee Pond. This experimental population fed omnivorously, with adult bonytail consuming algae, vegetative material, small fish, and crayfish (*Procambarus* and *Orconectes* spp.). Young bonytail were documented to feed near the surface of the pond, with a gut analysis demonstrating that smaller size classes typically fed on zooplankton and invertebrates (Marsh, Mueller, and Schooley 2013).

3.6.1.4 STATUS AND DISTRIBUTION

Status

The bonytail was listed as an endangered species throughout its range on April 23, 1980 (*Federal Register* 45:27710). The *Bonytail* (Gila elegans) *Recovery Plan* was completed in 1990 (USFWS 1990) and revised by the 1990 *Bonytail Chub Recovery Plan* (USFWS 1990), as amended, and supplemented by the 2002 *Bonytail* (Gila elegans) *Recovery Goals: Amendment and Supplement to the Bonytail Chub Recovery Plan* (USFWS 2002c). The recovery goals included site-specific management actions for the Lower Colorado River Basin that included the following: adequate habitat, protection from take, protection from disease, adequate regulatory mechanisms, and protections from human-made or natural factors. The most recent 5-year review of the species status determined that the bonytail remains endangered as of June 27, 2019 (*Federal Register* 81:33698; USFWS 2019).

Distribution

Range Wide

Bonytail were once widely distributed throughout the Colorado River and its tributaries. This species is stocked in both the Upper and Lower Basins; however, survival is extremely low as indicated in the most recent 5-year review (USFWS 2019).

Early collections of bonytail in the lower Colorado River include 16 specimens from Grand Canyon in the 1940s (USFWS 2002c). The last large concentration of bonytail was seen in 1954, when about 500 adults were observed spawning over a gravel shelf in Lake Mohave, Arizona/Nevada. Of 34 adult bonytail captured in Lake Mohave between 1976 and 1988, 11 were used as the original brood stock for the recent and present stocking program. This consists of a low genetic diversity for the species and the fish used in the augmentation program.

There are four isolated backwaters where bonytail have been consistently recruiting and are likely self-sustaining, including Cibola High Levee Pond (CHLP) and three ponds at Imperial Ponds Conservation Area (IPCA). These locations are managed specifically for native fishes and nonnative fish species are excluded. The CHLP is an approximately 5-acre pond that was historically part of the Colorado River channel. The pond is on the Cibola NWR, approximately 5 miles south of Palo Verde, California, in Reach 4 of the LCR MSCP planning area. The pond is hydrologically connected to the river through a porous river levee (Marsh, Mueller, and Schwemm 2013), and water exchange occurs by gravity and the flow of the river (Marr and Velasco 2005). The population is extant today with approximately 1,200 bonytail (USFWS 2020b). The IPCA is on the Imperial NWR in Reach 5 of the LCR MSCP planning area. The IPCA consists of six disconnected backwaters totaling 80 acres created as backwater habitat for razorback suckers (*Xyrauchen texanus*) and bonytail (Swatzell et al. 2022). Two groundwater wells supply water to all six ponds, three of which are being managed specifically for bonytail. The population is extant and recruiting with approximately 160 bonytail (Swatzell et al. 2022).

Both CHLP and IPCA ponds have required periodic renovations prior to or since being established as native fish refugia. CHLP was initially developed as a grow-out pond for bonytail and razorback sucker in 1993 (La Barbara and Minckley 1999). The pond supported recruiting populations of both species for approximately 10 years; however, native fish recruitment ceased in CHLP after the illegal introduction and reproduction of largemouth bass in the pond in 2003 (Mueller 2007). The pond was renovated and restocked to establish CHLP as a native fish sanctuary. The IPCA ponds have also undergone multiple renovations to remove nonnative fishes and have also experienced periodic fish die-offs, likely due to extremely low dissolved oxygen levels that may occur in summer months. The Southwestern Native

Aquatic Resources and Recovery Center and the Mora National Fish Hatchery currently maintain bonytail and razorback sucker brood stocks for propagation and as a backup should a brood stock be lost. These brood stocks can be used to replace native fishes that may be periodically lost in isolated habitats.

REASON FOR LISTING AND CURRENT THREATS

Interactions between bonytail and introduced nonnative species have been recognized as one of the major factors contributing to the decline of this species (Pacey and Marsh 1998; USFWS 1990). Bonytail have repeatedly exhibited successful spawning and recruitment in predator-free environments, and historically maintained strong populations that coexisted with other native fish (Mueller 2006; Pacey and Marsh 1998). Jonez and Sumner (1954) observed common carp (*Cyprinus carpio*) interspersed with spawning bonytail in Lake Mohave and indicated that these common carp probably consumed most of the eggs. Channel catfish (*Ictalurus punctatus*), largemouth bass and other centrarchids, shad (*Dorosoma* spp.), and shiners (*Cyprinella* spp.) probably feed on larvae or young juveniles. Predation by nonnative fish is devastating to bonytail during early life stages, and competition may negatively affect adults. Predation by piscivorous birds is also a threat to bonytail. Humphrey et al. (2016) observed direct predation of bonytail by great blue heron (*Ardea herodias*) and evidence of predation by double-breasted cormorant (*Phalacrocorax auratus*) during multiple study years in Reach 3 of the LCR MSCP planning area. Mueller et al. (n.d. [2023]) monitored avian predation following five separate bonytail stocking events from 2015 through 2017 and reported that 0% to 5% of stocked fish were preyed on by great blue herons, cormorants, and osprey within a 9- to 13-day period. Only the larger subadults have been able to survive when stocked into environments containing nonnative predators. There are currently no known populations of bonytail in the mainstem lower Colorado River; however, multiple small populations persist in off-channel habitats that are free of nonnative fish species.

Another contributor to the decline of bonytail populations is the impact of water resource development. The construction of dams has altered flow, temperature, cover, substrate, and other environmental conditions defining bonytail habitat. The dams themselves act as barriers to migration, population expansion, and larval drift. The unnatural (but often more stable) environmental conditions that are created by impoundments are often more conducive to introduced fish species. It is likely that interactions with nonnative fish and water resource management have worked synergistically to reduce bonytail populations.

The unnatural flow and temperature regimes resulting from impoundments have been credited with disrupting normal biological functions of native fish in the Upper Basin. Vanicek and Kramer (1969) found that the effects of Flaming Gorge Dam inhibit the spawning of native fish for more than 96 kilometers (60 miles) downstream. Reduced spring flows and increased flows from summer to winter result in a change of flow patterns, sediment loads, and water temperature (Muth et al. 2000). Growth rate of roundtail chub was also reportedly reduced. The change in flow and temperature regimes may also be responsible for interfering with factors governing reproductive isolation. Bonytail can hybridize with other members of the genus *Gila*. Collection and identification of hybrids in the Upper Basin suggest that the effects of water resource development may be increasing the occurrence of hybridization (Valdez and Clemmer 1982). Currently, bonytail in the Lower Basin are not found in riverine areas outside the lower Colorado River and have little or no exposure to other members of the genus *Gila*. However, if populations become established in other riverine portions of the Lower Basin, the previously discussed threats and limiting factors will apply to these populations. The only direct threats from water resource development in the Lower Basin currently are habitat loss from reservoir fluctuations and entrainment at hydropower facilities.

Analysis of the Species/Critical Habitat to Likely be Affected

The analysis will include bonytail habitat along the mainstem of the lower Colorado River and natural and human-made connected and disconnected backwaters in Reaches 3 through 5, e.g., CHLP and the Big Bend, Mohave Valley, Section 26, and Imperial Ponds Conservation Areas, etc.

Critical habitat includes the Colorado River from Hoover Dam to Davis Dam (Reach 2), including Lake Mohave up to its full pool elevation, and the Colorado River from the northern boundary of Havasu NWR to Parker Dam, including Lake Havasu up to its full pool elevation (Reach 3).

Environmental Baseline

STATUS OF SPECIES WITHIN THE ACTION AREA

The LCR MSCP provides a level of funding to support implementation of a fish stocking/augmentation program providing for the stocking of up to 620,000 subadult bonytail for reintroduction into the Colorado River over a 50-year term. During 2005 through 2022, 132,762 bonytail were stocked into Reaches 2 through 5.

Reach 2

As of fiscal year (FY) 2022 (FY22), the LCR MSCP has released 3,505 bonytail into Reach 2 (LCR MSCP 2023). These releases were initiated to gather information on post-stocking distribution, habitat selection, habitat use, and survival, with the goal of using this information to 1) indicate locations that may be better suited for stocking native fishes, 2) assist in developing a more robust monitoring network in terms of where to locate remote sensing equipment or other sampling gear to increase contact probabilities, and 3) identify locations where native fishes aggregate. Research and monitoring efforts have returned only short-term recontact data, and few individuals have been contacted more than 12 months post release. Due to the limited number of long-term recontacts, no population estimate is available for this reach.

In Reach 2, bonytail were historically observed spawning over gravel, cobble, and rocky substrates at depths of 1.5 to 3.5 meters (Jonez and Sumner 1954). Bonytail have rarely been contacted following stockings in the lower Colorado River, and no observations of physical spawning condition or activity have been documented in Reach 2. There are currently no known spawning locations for bonytail in the lower Colorado River.

Reaches 3 through 5

As of FY22, the LCR MSCP has released over 66,000 bonytail into Reach 3 and over 63,000 bonytail into Reaches 4 and 5 (LCR MSCP 2023) (Table 3-5). Research and monitoring efforts have generally returned only short-term recontact data, typically within the first several months following release, and few individuals have been contacted more than 12 months post release. Due to the limited number of long-term recontacts, no population estimates are available for these reaches.

There are currently no known spawning locations for bonytail in the mainstem lower Colorado River, and no observations of physical spawning condition or activity have been documented in the mainstem portion of Reaches 3 through 5. Bonytail have, however, persisted in multiple off-channel habitats that are free of nonnative fish species—i.e., CHLP and three ponds at the IPCA—demonstrating that successful spawning and recruitment have occurred in these habitats.

Table 3-5. Summary of Fish Augmentation Conservation Measure BONY3

Reach	Number of Bonytail, FY22	Bonytail Program
2	0	3,505*
3	2,045	66,152
4 and 5	3,971	63,105
Total	**6,016**	**132,762**

* The FY22 program total for bonytail includes 775 fish that were stocked in FY 2006 and not previously credited.

Critical Habitat

The bonytail was listed as endangered April 23, 1980 (*Federal Register* 45:27710), and critical habitat was designated March 21, 1994 (*Federal Register* 59:13374). Critical habitat includes the Colorado River from Hoover Dam to Davis Dam (Reach 2), including Lake Mohave up to its full pool elevation, and the Colorado River from the northern boundary of Havasu NWR to Parker Dam, including Lake Havasu up to its full pool elevation (Reach 3). Principle constituent elements of critical habitat include 1) water (a quantity of sufficient quality that is delivered to a specific location in accordance with a hydrologic regime that is required for the particular life stage); 2) physical habitat (areas of the Colorado River system that are inhabited or potentially habitable by bonytail for use in spawning, nursery, feeding, and rearing, or corridors between these areas); and 3) biological environment (food supply, predation, and competition) for each life stage (*Federal Register* 59:13374). There are 27,816 acres of bonytail critical habitat in Reach 2 and 19,962 acres of critical habitat in Reach 3 (*Federal Register* 59:13374).

Species Distribution and Regionally Significant Populations in the LCR MSCP Planning Area

Wild bonytail has been extirpated from the lower Colorado River and its tributaries. Although spawning does occur in the wild, there is no evidence of recruitment to the adult population. Wild adult assemblages in the LCR MSCP planning area were previously found in Lake Mohave (Reach 2), and there were reports that a few wild adults may have also persisted in Lake Havasu (Reach 3). The adult assemblages that survived did so due to their longevity; adults are known to reach 49 years of age (Minckley 1985). During the period between 1976 and 1988, 34 bonytail were captured from Lake Mohave, 11 of which were used as the original brood stock for the recent and ongoing stocking program. Some of these fish were incorporated into the establishment of a captive brood stock—the progeny of which are presently stocked into the lower Colorado River (Johnson and Jensen 1991; Minckley et al. 1989; USFWS 2002c) and several Upper Basin rivers. Bonytail abundance in Lake Mohave was consistently low in the early 1980s (Bozek et al. 1984) because of the mortality of older fish; however, wild adults and younger bonytail of adult size were still found in Lake Mohave in the 1990s (USFWS 2002c). Persistence of bonytail in the lower Colorado River currently relies on continued augmentation efforts (Marsh, Mueller, and Schwemm 2013; Pacey and Marsh 2008). As of FY22, 132,762 bonytail have been stocked into the lower Colorado River downstream of Hoover Dam (LCR MSCP 2023). Due to the limited number of long-term recontacts, no population estimate is available for any reach.

Management Needs, Existing Management Actions, and Recovery Goals

The immediate recovery goal for this species is to prevent its extinction. Quantifiable recovery goals for down listing and delisting were developed by the USFWS (USFWS 2002c). The recovery goals for the bonytail relevant to the lower Colorado River require the establishment and maintenance of a genetic

refuge in a suitable location (e.g., Lake Mohave, Lake Havasu) and two genetically and demographically viable, self-sustaining populations, each with 4,400 adults (USFWS 2002c).

The LCR MSCP is addressing components of recovery through implementation of an HCP. The HCP (LCR MSCP 2004a) describes the implementation strategy for conservation measures to aid in recovery of bonytail through habitat creation, the development of a genetic refugium, and augmentation stocking of up to 620,000 subadult fish into the lower Colorado River and its connective channels. The conservation measures associated with native fish augmentation were included in the HCP (LCR MSCP 2004a) as part of the best practices for achieving successful conservation of native fishes in the lower Colorado River. Augmenting lower Colorado River fish populations embraces the strategy of replacing fish that are depleted due to natural mortality and high predation rates. Included in the augmentation total are goals to stock up to 200,000 bonytail into LCR MSCP Reach 2 (Lake Mohave), 200,000 bonytail into Reach 3 (Davis to Parker Dam), and 220,000 bonytail into Reaches 4 and 5 (Parker to Imperial Dam). The demands for augmentation of this species can currently be met with the rearing capacity available to the program. Partner hatcheries and off-site rearing ponds have the annual capacity to produce 12,000 to 16,000 bonytail greater than 12 inches long for augmentation. The future annual demand for augmentation of this species is scheduled to increase, and the LCR MSCP is developing additional rearing capacity to meet this need.

Monitoring and research are required components of the HCP and are key elements of the LCR MSCP Adaptive Management Program. The intent of monitoring and research is to provide information for the adaptive management process so that the LCR MSCP can improve its effectiveness and efficiency in fulfilling the conservation goals associated with the fish augmentation program as described in the HCP (LCR MSCP 2004a). Research and monitoring efforts for the fish augmentation program fall into the following three general focus areas: 1) determining key environmental correlates affecting growth and survival during rearing, 2) understanding and minimizing adverse effects of transporting and stocking, and 3) understanding post-stocking distribution and survival. Stocking the appropriate number of native fishes into the lower Colorado River allows for the augmentation goals of the HCP to be met; however, survival of these stocked fishes is the simplest measure of conservation success. Survival rates are observed, recorded, and analyzed both during the rearing process and after fish are stocked. Regular monitoring through continuous sampling under the LCR MSCP will provide data on the populations of stocked fish. These data provide insight regarding the success of augmentation strategies and may alert resource agencies to new challenges in the future. These monitoring efforts are critical, and in some form, are expected to continue throughout the 50-year term of the LCR MSCP.

3.7 Razorback Sucker (*Xyrauchen texanus*)

3.7.1 Species Description, Life History, Population Dynamics

3.7.1.1 HABITAT

Adult razorback sucker habitat requirements vary, depending on season and location. Adult razorback suckers are adapted for swimming in swift currents, but they may also be found in eddies and backwaters away from the main current (Allan and Roden 1978). Ryden and Pfeifer (1995) observed that subadult razorback suckers use eddies, pools, backwaters, and other slow-water areas during spring runoff and move into swifter main channel areas during summer. Tyus and Karp (1990) report that, during spring runoff, adults use flooded lowlands and areas of low velocity. Tyus (1987) indicates that midchannel sandbars represent a common summer habitat. Bradford et al. (1998) conclude that adult razorback suckers in the lower Imperial Division area of the Colorado River actively selected backwaters; however, many backwaters become unavailable to fish because of the effects of regulated flows. In clear reservoirs,

adults are considered pelagic and can be found at various depths, except during the spawning period when they use shallow shoreline areas.

The preferred temperature range of the adult razorback sucker is 22.9ºC to 24.8ºC (Bulkley and Pimentel 1983). Estimates of upper and lower avoidance temperatures were from 27.4ºC to 31.6ºC and from 8.0ºC to 14.7ºC, respectively. These results indicated that low summer water temperature may have contributed to the disappearance of razorback sucker from the tailwaters of Flaming Gorge Reservoir on the Green River, Utah (Bulkley and Pimentel 1983) because water temperatures were well below the lower avoidance temperatures. Bulkley and Pimentel (1983) recommended summer water temperatures between 22ºC and 25ºC to provide suitable habitat for this species.

Little is known about juvenile habitat requirements because very few juveniles have been captured in the wild. Larval razorback suckers have been observed using nearshore areas in Lake Mohave. In riverine environments, young razorback suckers use shorelines, embayments, and tributary mouths (Minckley et al. 1991).

In 2011, a science panel determined that habitat in the lower Grand Canyon and Lake Mead inflow was suitable for spawning by razorback sucker, but nursery habitat was sparse upstream of the lake interface, which at the time was just below the Pearce Ferry Rapid (Valdez et al. 2011). In 2023, the interface is about 10 miles farther downstream near Sandy Point. An important element of habitat identified by the science panel was the presence of turbidity and vegetation to provide cover for the newly hatched larvae and young fish.

3.7.1.2 BREEDING

Razorback suckers move upstream to spawning areas and then back downstream after spawning. Increasing water flows and water temperatures are the main factors influencing the onset of spawning migration (Modde and Irving 1998; Tyus and Karp 1990). In the Lower Basin reservoirs, spawning occurs from January to April/May (Langhorst and Marsh 1986). Water temperatures observed during spawning in the Upper and Lower Colorado River Basins are similar at peak spawning (10ºC and 15ºC, respectively), despite the differences in timing and magnitude of natural high flows (Tyus 1987; Tyus and Karp 1990). Spawning success suggests that increased rates of discharge are not needed to successfully reproduce, but that they are important in small, genetically isolated populations to initiate movement of adults to spawning locations (Modde and Irving 1998).

During the spawning season, adult razorback sucker migrations have been documented in Lake Mohave, the Green River, the Middle Green River, and the lower Yampa River (Marsh and Minckley 1989; Modde and Irving 1998; Tyus 1987). Razorback sucker adults have demonstrated fidelity for spawning locations (Tyus and Karp 1990). Spawning in lakes and streams takes place over loosely packed gravel or cobble substrate in reaches with velocities less than 4.9 feet per second (Bradford and Vlach 1995).

Downstream movement of razorback suckers following spawning may be associated with feeding behavior (Tyus and Karp 1990). Razorback suckers may use wetland outlets and tributary mouths because of preferred temperature ranges or higher productivity (Modde and Irving 1998).

3.7.1.3 DIET

The razorback sucker is an omnivorous bottom feeder. Its diet depends on location and life stage (Bradford and Vlach 1995; Valdez and Carothers 1998). Larval razorback suckers were reported to feed on diatoms, rotifers, algae, and detritus (Wydoski and Wick 1998). Stomach contents of adult individuals collected in the riverine environment consist of algae and dipteran larvae, and adults examined from Lake Mohave were found to feed primarily on planktonic crustaceans (Minckley 1973).

3.7.1.4 STATUS AND DISTRIBUTION

Status

The razorback sucker was listed as endangered on October 23, 1991 (*Federal Register* 56:54958), with critical habitat designated March 21, 1994 (*Federal Register* 59:13374), which includes the Colorado River and its 100-year floodplain from the confluence with the Paria River (15 miles DGCD) downstream to Hoover Dam, and from Hoover Dam to Davis Dam. The *Razorback Sucker* (Xyrauchen texanus) *Recovery Plan* was approved in 1998 (USFWS 1998) and was amended and supplemented by the 2002 *Razorback Sucker* (Xyrauchen texanus) *Recovery Goals: Amendment and Supplement to the Razorback Sucker Recovery Plan* (USFWS 2002d). The recovery goals included site-specific management tasks for the Lower Colorado River Basin that included the following: adequate habitat, protection from take, protection from disease, adequate regulatory mechanisms, and protections from human-made or natural factors. The recently completed USFWS species status assessment and 5-year status review concluded that the current risk of extinction for the razorback sucker is low and the species is no longer in danger of extinction (USFWS 2018b). A Section 4(d) rule proposed in 2021 proposes to reclassify the razorback sucker from endangered to threatened (*Federal Register* 86:35708–35728). However, a decision on the reclassification is pending.

Distribution

Range Wide

Historically, the razorback sucker inhabited the Colorado River and its tributaries from Wyoming to the Gulf of California. Razorback suckers were found in the Gila, Salt, and Verde Rivers, which are tributaries of the lower Colorado River.

Like many fish native to the lower Colorado River, the razorback sucker has evolved to survive and flourish in large rivers in the presence of other native fish. If historical conditions were to return to the Lower Basin, razorback sucker populations would likely respond positively. Water resource development and interactions with nonnative fish species currently threaten the razorback sucker (Pacey and Marsh 1998). The limiting factors resulting from these two major threats include altered temperature and flow regimes, habitat loss, habitat fragmentation, predation, competition, and increased risk of disease and parasitism. Populations in the lower Colorado River have persisted largely as a result of augmentation stockings, but the limiting factors in the system continue to reduce the likelihood of developing self-sustaining populations.

The razorback sucker is now found in eight geographic areas representing populations including four in the Upper Colorado River Basin (Green River, Colorado River, San Juan River, and Lake Powell) and four in the Lower Colorado River Basin (Lake Mead, Lake Mohave, the Colorado River between Davis and Parker Dams [Lake Havasu], and the Colorado River downstream of Parker Dam) (USFWS 2018c).

REASON FOR LISTING AND CURRENT THREATS

The primary limiting factor for razorback suckers in the Lower Basin is probably the direct effect of predation on early life stages by nonnative fishes (Johnson and Hines 1999; Marsh et al. 2005; Mueller 2006; Mueller and Carpenter 2008; Pacey and Marsh 1998). Although several nonnative species prey on razorback sucker eggs, larvae, and stocked subadults, little work has been done to measure the direct effect of predation. Johnson and Hines (1999) demonstrated in a laboratory experiment that green sunfish can consume more than 99% of razorback sucker larvae in clear water. In Lake Mohave, similar clear water conditions exist, and predation on razorback sucker larvae by juvenile bluegills and green sunfish has been demonstrated using molecular techniques (Ehlo et al. 2017). Minckley et al. (1991) suggest that

the best evidence related to the effects of predation is that successful spawning and recruitment are commonly reported from predator-free environments. Spawning occurs in Reaches 1 through 4, and many eggs survive and become larvae. However, few larvae, if any, survive to the subadult stage. During the past few decades, the population dynamics of razorback suckers at different locations in the Lower Basin have exhibited similar trends. Adult fish were observed in each population; however, juveniles were rare. Although wild populations of razorback suckers were observed spawning in various locations in the Lower Basin, recruitment was never successful enough to replenish the adult populations. Eventually, the adult fish died of old age, and wild populations became reduced or extirpated. The lack of recruitment in these populations is thought to be primarily a result of predation by nonnative fish on early life stages.

Another limiting factor that is directly related to the flow regime is loss of habitat. The comparatively stable and cool flows that now occur downstream of impoundments during the spring and early summer have replaced what was once a warm, dynamic, riverine environment (Holden and Stalnaker 1975; Joseph et al. 1977; Minckley et al. 1991; Wick et al. 1982). Historically, high spring and summer flows created large backwater and off-channel areas that may have been important habitat for early life stages of razorback suckers. Dams and impoundments also act as barriers to larval drift, species expansion, and migration.

Analysis of the Species/Critical Habitat to Likely be Affected

The analysis will include razorback sucker habitat along the mainstem of the lower Colorado River and natural and human-made connected and disconnected backwaters in Reaches 3 through 5, e.g., the A10 backwater and the Big Bend, Mohave Valley, Section 26, and Imperial Ponds Conservation Areas, etc.

Critical habitat includes Lake Mead up to its full-pool elevation (Reach 1); the Colorado River and its 100-year floodplain from Hoover Dam to Davis Dam, including Lake Mohave up to its full-pool elevation (Reach 2); and the Colorado River and its 100-year floodplain from Parker Dam to Imperial Dam, including Imperial Reservoir to the full-pool elevation or 100-year floodplain, whichever is greater (Reaches 4 and 5).

Environmental Baseline

STATUS OF SPECIES WITHIN THE ACTION AREA

Historically, the largest and most genetically diverse population of razorback suckers in the LCR MSCP planning area occurred in Lake Mohave. Smaller populations occurred in Lake Mead, the Colorado River below Davis Dam, and Senator Wash Reservoir (Bradford and Vlach 1995). Razorback suckers were also captured sporadically from the mainstem Colorado River, impoundments, and canals (Marsh and Minckley 1989). Valdez and Carothers (1998) indicated that a small population also existed in the Grand Canyon section of the Colorado River.

The razorback sucker population in Lake Mohave experienced considerable decline over the last 30 years. The Lake Mohave population was estimated to contain 60,000 individuals in 1988 (Minckley et al. 1991), but by the mid-1990s, less than 25,000 razorback suckers were thought to exist there (Marsh et al. 2003). This population continued to decline through the 1990s, and by 2001 it was estimated to contain fewer than 3,000 individuals (Marsh et al. 2003). Despite a declining population, razorback sucker spawning continued to be successful, and more than 20,000 wild razorback sucker larvae were collected in 1995 from Lake Mohave (Reclamation 1996). Since that time, capture of wild-born larvae has continued annually, with 15,000 to 100,000 being captured each year for rearing at off-site facilities. Virtually no juvenile or adult recruitment has been detected in Lake Mohave; however, this population has been maintained through annual stockings.

Razorback suckers within the action area are currently distributed in the mainstem lower Colorado River between Lake Mead, Lake Mohave, the riverine reach between Davis Dam and Lake Havasu, and below Parker Dam. Combined data from 1990 to 1997 suggested that the total population of razorback suckers in Lake Mead during 1997 was between 400 and 450 individuals. Successful spawning has been documented at multiple locations in Lake Mead on an annual basis since 2005. This population has remained stable over the last 20 years and is currently estimated at 578 individuals (Rogers et al. 2023). The Lake Mohave population has remained stable in recent years and is currently estimated at 5,037 individuals (Saucier et al. 2023). The population of razorback suckers between Davis Dam and Lake Havasu has responded well to augmentation efforts and is currently estimated at 5,406 individuals (LCR MSCP 2023). The population of razorback suckers below Parker Dam has increased in recent years due to continued augmentation efforts and consistent data collection at two main spawning locations and is currently estimated at 1,162 individuals (Heishman et al. 2023). Razorback sucker population estimates for FY 2021 (FY21) are summarized in Table 3-6.

Table 3-6. Population Estimates for Razorback Suckers by LCR MSCP River Reach in FY21

Reach	Mark-Recapture Period	Razorback Sucker Population Estimate
Reach 1 (Lake Mead)	**07/01/2020 to 06/30/2022**	**578**
Reach 2 (Lake Mohave)	01/01/2021 to 04/30/2022	5,037
Reach 3	01/01/2021 to 04/30/2022	5,406
Reaches 4 and 5	01/01/2021 to 04/30/2022	1,162

Reach 1

Razorback suckers in Lake Mead are concentrated near the inflows of the Colorado River, Virgin/Muddy Rivers, and the Las Vegas Wash, where the fish aggregate in spring to spawn. Some passive integrated transponder (PIT)-tagged fish have been detected in the Colorado River as far upstream as 100 miles, which is the base of Lava Falls Rapid. Small numbers of larval razorback sucker are found in the Colorado River in the lower Grand Canyon, with greater numbers in the Lake Mead inflow. The Colorado River in 2023 extends to Sandy Point, about 15 miles downstream of Pearce Ferry, before forming the interface with the lake. Upstream fish movement is impeded by a narrow constriction in the river channel downstream of Pearce Ferry, at what is called the "Pearce Ferry Rapid."

The razorback sucker population in Lake Mead is the only population in the Lower Colorado River Basin in which there is evidence of natural recruitment. The population apparently benefited from abundant habitat during the initial filling of the reservoir prior to a rapid decline that began in the 1970s. Recruitment of wild origin razorback sucker was documented nearly annually in Lake Mead between the 1970s and the 1990s. Reproduction and natural recruitment have been documented annually in turbid inflow areas (i.e., Las Vegas Bay, Echo Bay, and the inflow area of the Virgin and Muddy Rivers) since the 1990s (USFWS 2018c). Based on data obtained from aging of approximately 650 individuals captured through FY22, recruitment has continued to occur in pulses since the early 2000s (Rogers et al. 2023).

Despite the dominance of nonnative fishes in Lake Mead, the razorback sucker continues to reproduce and recruit naturally on an annual basis (USFWS 2018c). Although predation of juvenile razorback sucker by nonnative fishes occurs, predation and competition do not appear to be limiting factors in the viability of the Lake Mead razorback sucker population but may limit the population size (USFWS 2018c). Considerable variation in lake elevation also does not appear to be a limiting factor for the viability of this population. From 2007 to 2022, month-end lake elevations ranged from a low of approximately 1,041 feet to a high of 1,134 feet. During this period, little correlation between elevation

and larval production was observed (Rogers et al. 2023), demonstrating that suitable spawning habitat is available for razorback suckers and larval production occurs at a range of elevations. Cover in the form of turbidity and submerged vegetation in inflow areas seem to be the key features of Lake Mead that provide necessary conditions for survival and recruitment of larvae and juveniles despite the presence of a full suite of nonnative fishes (Albrecht et al. 2017). The population in Lake Mead is likely to persist as long as these conditions are present.

Reach 2

All razorback suckers in Lake Mohave and the Colorado River below Hoover Dam are repatriated individuals; wild larvae are collected on an annual basis and raised in hatcheries, then returned to the river. The Lake Mohave repatriated population was most recently estimated at 5,037 individuals (95% confidence interval [CI] from 4,854 to 5,219) (Saucier et al. 2023). Spawning and egg production occur annually at multiple locations and up to about 30,000 larvae are collected annually throughout the spawning season for hatchery rearing and future repatriation. Spawning occurs from late January to May. Recruitment in this reach is undocumented and if it occurs, it is probably minimal (USFWS 2018c). This population of razorback sucker has the highest level of genetic diversity, but the wild population is assumed extirpated, and the population is sustained only by stocking. The population is relatively stable in the presence of active repatriation, although it has declined from historic highs, despite augmentation (USFWS 2018c).

The diversity of mitochondrial DNA in razorback sucker from Lake Mohave is remarkably high, indicating that the contemporary population consists of direct descendants of a large, diverse, panmictic population that historically inhabited the Lower Basin (Dowling et al. 1996). Populations in the Upper Basin are less diverse and possess fewer unique genotypes, suggesting that the razorback sucker thrived in the early lakes and abundant floodplains of the Lower Basin before dispersing to other parts of the Colorado River system. Retention of the genetic diversity found in the extant Lake Mohave razorback sucker population remains important for conservation of the species.

Prior to 2005, approximately 98,000 razorback suckers were released into Reach 2 to conserve the population and its genetic diversity. As of FY22, the LCR MSCP has released an additional 154,798 razorback suckers to augment this population (LCR MSCP 2023). Remote PIT scanning has been used since 2011 to successfully contact razorback suckers throughout Reach 2 (Table 3-7). These monitoring efforts have greatly increased contact and recontact rates for native fishes, allowing for more accurate population estimates to be generated on an annual basis. Population estimates for the 2016–2022 monitoring years are presented in Table 3-8.

Table 3-7. Razorback Suckers Contacted via Remote PIT Scanning; LCR MSCP Reach 2, 2016–2022

Year	Number of Unique Razorback Suckers
2016	3,128
2017	3,490
2018	3,652
2019	4,225
2020	5,870
2021	4,602
2022	4,970

Table 3-8. Razorback Sucker Population Estimates; LCR MSCP Reach 2, 2015–2022

Year	Population Estimate	95% CI
2015–2016	3,550	3,437–3,662
2016–2017	3,759	3,645–3,872
2017–2018	3,544	3,437–3,650
2018–2019	3,605	3,515–3,694
2019–2020	3,906	3,789–4,002
2020–2021	5,100	4,944–5,255
2021–2022	5,037	4,854–5,219

Spawning habitat for razorback suckers is characterized by relatively shallow, flat to gently sloping shoreline areas with clean gravel, cobble, or mixed substrates (Albrecht et al. 2013; Bestgen 1990; Kegerries et al. 2009; Kesner et al. 2012; Mueller and Marsh 1998). Spawning typically occurs in 0.5 to 2 meters of water, but it has also been reported at depths of 10 to 20 meters in lower Colorado River reservoirs (Holden et al. 1997; Holden et al. 1999; Minckley et al. 1991; Valdez et al. 2012). Four known spawning locations (i.e., areas attracting spawning groups of > 100 razorback suckers) are currently monitored in Reach 2 on an annual basis (Table 3-9). These spawning locations occur in both the lentic and lotic portions of Lake Mohave. To protect the shallower razorback sucker spawning habitat and fertilized eggs from the effects of wave action or desiccation in lentic areas, the elevation of Lake Mohave is managed so that it does not drop more than two vertical feet during any 10-day period from February through April. Ten days provides adequate time for hatching of eggs in spring water temperatures. Lotic spawning habitat, e.g., Black Bar, can be more affected by elevation changes due to its proximity to Hoover Dam. Although daily fluctuations may occur in these areas, adult razorback suckers have continued to find suitable spawning habitat throughout the spawning season each year and over 74,000 larvae were captured from these areas and delivered to hatcheries for rearing from 2019 through 2023.

Table 3-9. Razorback Sucker Spawning Locations; LCR MSCP Reach 2

Name	UTM (Easting)	UTM (Northing)	Latitude	Longitude	River Mile
Black Bar	706780	3977568	35.920593	−114.708181	334
Yuma Cove	712669	3933587	35.523115	−114.654613	300
Tequila Cove	710610	3928238	35.475360	−114.678687	297
Halfway Wash	710652	3922776	35.426146	−114.679641	293

Reach 3

For Reach 3, Davis Dam to Parker Dam, there are about 5,400 adult razorback suckers, all stocked from hatcheries. Razorback suckers have been observed spawning near Davis Dam and downstream through the Havasu NWR. Larval razorback suckers are abundant in this portion of the reach, but no wild juvenile/adult fish have been documented in recent years. Natural recruitment of razorback suckers occurred when the reservoir was initially built, but the introduction of nonnative sport fishes has since eliminated any natural recruitment (Bullard et al. 2022). About 6,000 to 12,000 adult razorback suckers are stocked annually at a size of 350 mm total length, with a survival rate of about 10% (USFWS 2018c). The genetic diversity of fish from this reach is similar to that of fish from Lake Mohave, although hybridization may occur with flannelmouth sucker (*Catostomus latipinnis*). The wild population is

assumed extirpated, but the population that consists of stocked/repatriated adults is stable and may be increasing (USFWS 2018c).

Razorback suckers have been documented in both backwater and riverine habitat extending upstream from Lake Havasu to Davis Dam (river miles 217–276). Documented captures and contacts have occurred at approximately 20 backwater and 50 riverine locations since remote PIT scanning was adopted as the primary method of monitoring. Current data suggest that habitat use is similar across seasons; however, large aggregations of razorback sucker have been documented in both habitats during the spawning season (January–April). Since 2014, over 7,000 unique razorback suckers have been captured or contacted at known and suspected spawning locations in Reach 3.

Razorback suckers were stocked into Reach 3 in the early 1990s. Studies conducted in the early 2000s suggested that a portion of these fish integrated with wild individuals and established a spawning population in the riverine portion of the reach approximately 0.5 to 1.5 miles upstream of Needles, California. Traditional sampling methods had limited success in capturing large numbers of razorback suckers during the study period (< 60 fish were captured each year from 2003–2005), resulting in low-precision population estimates for those years. Wydoski and Mueller (2006) reported these estimates as 3,750 individuals (95% CI: 1,306–8,925) in 2003, 1,768 individuals (95% CI: 878–3,867) in 2004, and 1,652 individuals (95% CI: 706–5,164) in 2005.

As of FY22, the LCR MSCP has released over 123,000 razorback suckers to augment the Reach 3 population (LCR MSCP 2023). Remote PIT scanning has been used to monitor this population since 2011, and during the last 7 years (2016–2022), it has been used in conjunction with traditional sampling methods to successfully contact large numbers of razorback suckers throughout the upper portion of the reach (river miles 217–276) (Table 3-10). These monitoring efforts have greatly increased contact and recontact rates for native fishes, allowing for more accurate population estimates to be generated on an annual basis. Population estimates for the 2015–2022 monitoring years are presented in Table 3-11.

Table 3-10. Razorback Suckers Captured or Contacted in LCR MSCP Reach 3, 2016–2022

Year	Number of Unique Razorback Suckers
2016	3,027
2017	3,306
2018	3,371
2019	5,552
2020	8,674
2021	9,106
2022	5,677

Table 3-11. Razorback Sucker Population Estimates, LCR MSCP Reach 3, 2015–2022

Year	Population Estimate	95% CI
2015–2016	4,346	4,164–4,528
2016–2017	4,540	4,247–4,834
2017–2018	3,672	3,278–4,066
2018–2019	4,896	4,719–5,097
2019–2020	4,864	4,633–5,095

Year	Population Estimate	95% CI
2020–2021	4,957	4,724–5,191
2021–2022	5,406	5,218–5,594

Razorback sucker spawning in Reach 3 has generally been observed at depths of less than 2 meters. Razorback suckers are confirmed or suspected of spawning in the river and its associated backwaters from Laughlin, Nevada, downstream to Topock Gorge. Six known spawning locations (i.e., areas attracting spawning groups of ≥ 100 razorback suckers) are currently monitored on an annual basis (Table 3-12). Despite daily fluctuations in river stage throughout the spawning season, razorback sucker larvae were present at targeted sampling locations in recent years (Bullard et al. 2019, 2022; Bullard and Best 2022). This suggests that not all spawning habitat is affected by these fluctuations, or other suitable spawning habitat is available at different river stages.

Bathymetric data of spawning locations are provided in Attachment 1. Bathymetric data included cross-sectional data for the 2.083 maf reduction at the sites listed in Table 3-12. No substrate information was reported during cross section surveys. An example of cross-sectional data for the Cliffs spawning site with minimum and maximum daily water elevations at the 2.083 maf reduction is provided in Figure 3-6. Remote PIT scanning has contacted several hundred razorback suckers at this location throughout the spawning season for multiple years.

Table 3-12. Razorback Sucker Spawning Locations, LCR MSCP Reach 3

Name	General Location	UTM (Easting)	UTM (Northing)	Latitude	Longitude	River Mile
Razorback Island	Laughlin	714631	3887040	35.103336	−114.645183	267
Cliffs	Needles (North)	716245	3861468	34.872594	−114.634131	248
White Wall	Needles	716656	3860628	34.864939	−114.629855	247
Power Lines	Needles	717290	3860020	34.859325	−114.623082	247
Airport Wash	Needles (South)	722026	3853531	34.799839	−114.573033	242
Manzanita Wash	Needles (South)	722207	3852868	34.793826	−114.571231	241

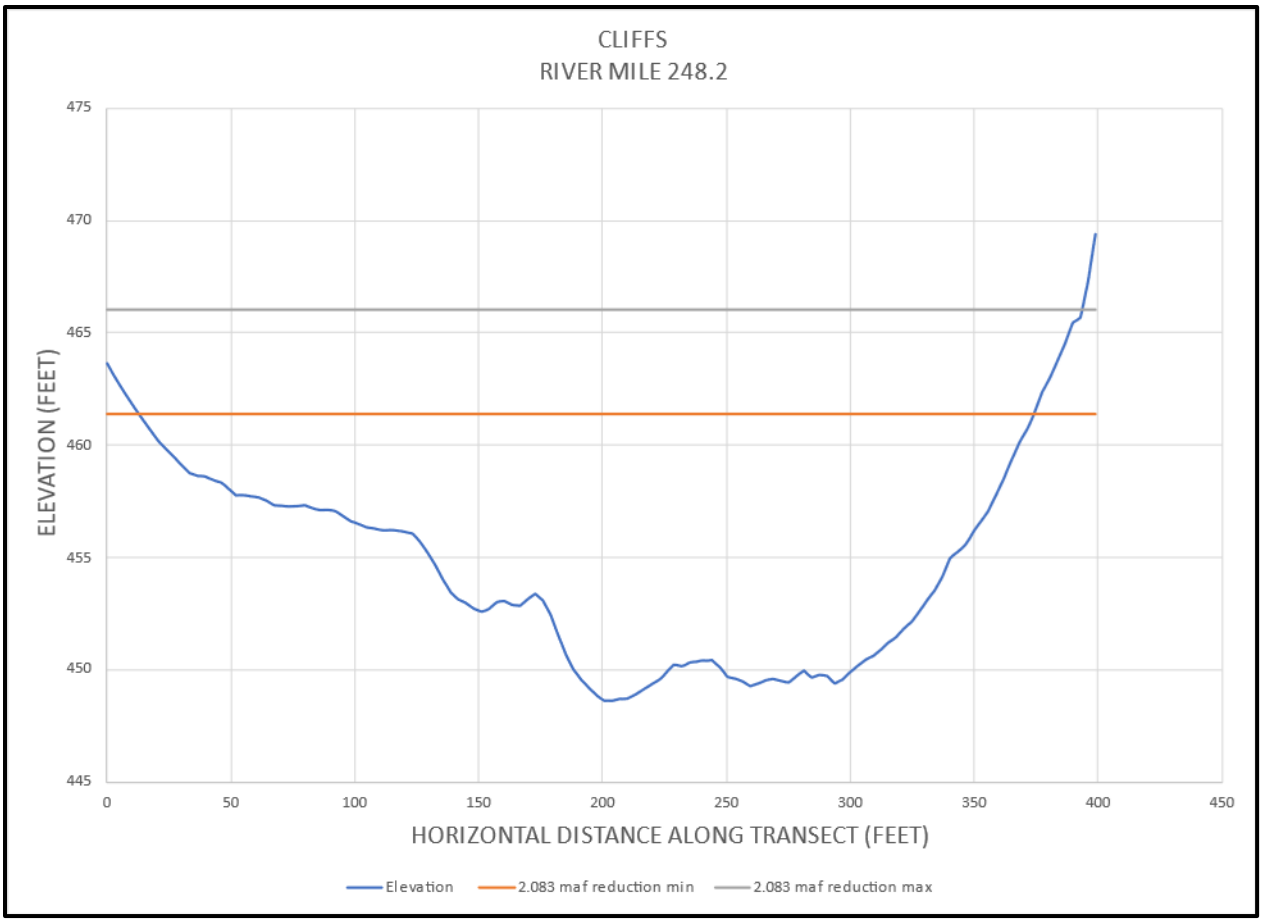


Figure 3-6. River cross section at the Cliffs spawning site, LCR MSCP Reach 3.

min = minimum, max = maximum

Reaches 4 and 5

For the Colorado River below Parker Dam (LCR MSCP Reaches 4 and 5), the razorback sucker population estimate has increased in recent years due to continued augmentation efforts and consistent data collection at two main spawning locations. The population is currently estimated at 1,162 individuals. Low-level spawning and egg production have been observed in backwater habitat at Senator Wash Reservoir and various backwaters in Blythe, California, where larvae have been captured (USFWS 2018c). There is no evidence of natural recruitment in these reaches. About 6,000 to 12,000 fish are stocked annually in these reaches. The genetic integrity of razorback suckers in these reaches is managed through stocking efforts and inbreeding has not been a concern. This population is not stable and maintained only by stocking (USFWS 2018c).

As of FY22, the LCR MSCP has released over 150,000 razorback suckers to augment the Reach 4 and 5 population (LCR MSCP 2023). Remote PIT scanning has been used since 2015 to contact razorback suckers throughout Reaches 4 and 5 (Table 3-13). These monitoring efforts have greatly increased contact and recontact rates for native fishes in recent years, allowing for population estimates to be generated on an annual basis since 2017. Population estimates for the 2017–2022 monitoring years are presented in Table 3-14.

Table 3-13. Razorback Suckers Contacted via Remote PIT Scanning; LCR MSCP Reaches 4 and 5, 2017–2022

Year	Number of Unique Razorback Suckers
2017	443
2018	1,234
2019	1,836
2020	3,194
2021	5,082
2022	1,767

Table 3-14. Razorback Sucker Population Estimates, LCR MSCP Reaches 4 and 5, 2017–2022

Year	Population Estimate	95% CI
2017–2018	154	140–168
2018–2019	147	123–171
2019–2020	359	341–377
2020–2021	938	909–967
2021–2022	1,162	1,105–1,219

In Reach 4, razorback suckers are confirmed or suspected of spawning in the river and adjacent backwaters. Large aggregations of razorback sucker have been observed at two locations (Table 3-15) each year since 2019, and the capture of razorback sucker larvae near these locations demonstrates successful spawning. These two known spawning locations are currently monitored on an annual basis.

Bathymetric data of spawning locations are in Attachment 1. Bathymetric data included cross-sectional data for the 2.083 maf reductions at the C7 gravel bar in Table 3-15. No substrate information was reported during cross section surveys. An example of cross-sectional data for the C7 gravel bar with minimum and maximum daily water elevations at the 2.083 maf reduction is provided in Figure 3-7. Remote PIT scanning has contacted several hundred razorback suckers at this location throughout the spawning season for multiple years. Reductions in flow are expected to have temporary impacts to shallow bar habitat. Comparative aerial imagery showing water elevations for the A-10 backwater in 2004 and 2020 is provided in Attachment 2.

Table 3-15. Razorback Sucker Spawning Locations, LCR MSCP Reaches 4 and 5

Name	General Location	UTM (Easting)	UTM (Northing)	Latitude	Longitude	River Mile
A10 Backwater	Not applicable	726786	3711883	33.522495	−114.558090	114.1
C7 Gravel Bar	Not applicable	726432	3711238	33.516754	−114.562061	113.8

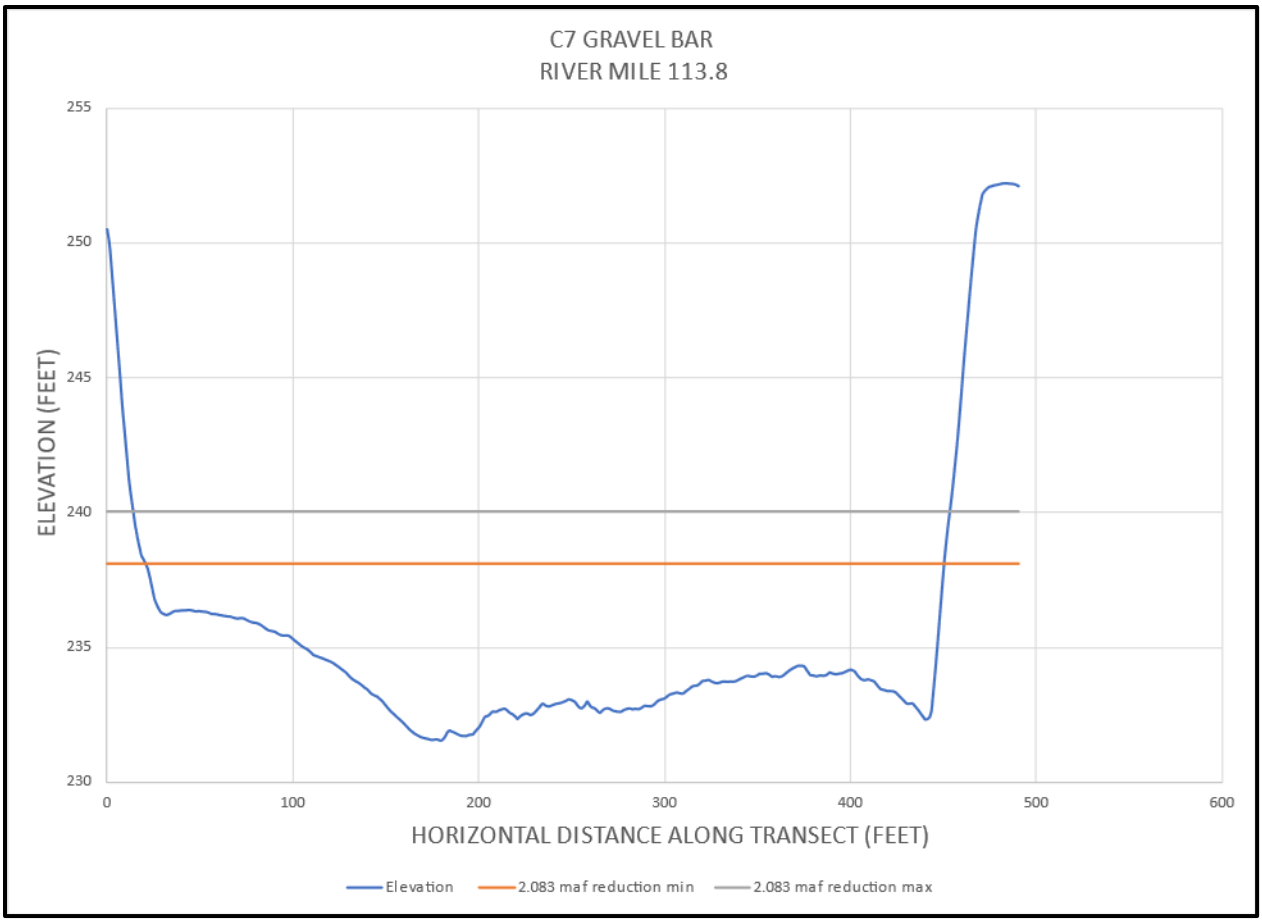


Figure 3-7. River cross-section at the C7 gravel bar spawning site, LCR MSCP Reach 4.

min = minimum, max = maximum

Critical Habitat

The razorback sucker was listed as endangered in 1991 (*Federal Register* 56:54958) with critical habitat designated March 21, 1994 (*Federal Register* 59:13374), which includes Lake Mead up to its full-pool elevation (Reach 1); the Colorado River and its 100-year floodplain from Hoover Dam to Davis Dam, including Lake Mohave up to its full-pool elevation (Reach 2); and the Colorado River and its 100-year floodplain from Parker Dam to Imperial Dam, including Imperial Reservoir to the full-pool elevation or 100-year floodplain, whichever is greater (Reaches 4 and 5). Principle constituent elements of critical habitat include 1) water (a quantity of sufficient quality that is delivered to a specific location in accordance with a hydrologic regime that is required for the particular life stage); 2) physical habitat (areas of the Colorado River system that are inhabited or potentially habitable by the sucker for use in spawning, nursery, feeding, and rearing, or corridors between these areas); and 3) biological environment (food supply, predation, and competition) for each life stage (*Federal Register* 59:13374).

Management Needs, Current Management Actions, and Recovery Goals

The short-term recovery goal for this species is to prevent its extinction. Quantifiable recovery goals for down listing and delisting were developed by the USFWS (USFWS 2002d).

The recovery goals for the razorback sucker relevant to the lower Colorado River require the establishment and maintenance of a genetic refugium in Lake Mohave and two self-sustaining

populations, each with 5,800 adults. The recovery goals for the razorback sucker list the following specific management needs to ensure recovery of this species (USFWS 2002d):

- Maintain existing genetic diversity in hatchery refugia and increase diversity if possible;
- Reverse the decline of this species and increase and stabilize existing populations in Lake Mohave, the middle Green River, Yampa River, and lower Green River by management actions;
- Protect the habitats of these populations from further degradation;
- Restore habitats to make them compatible with recovery goals; and
- Augment or reestablish populations of the fish in its critical habitat (USFWS 1998).

The LCR MSCP is addressing components of recovery through implementation of an HCP. The HCP (LCR MSCP 2004a) describes the implementation strategy for conservation measures to aid in recovery of razorback sucker through habitat creation, the development of a genetic refugium, and augmentation stocking of up to 660,000 subadult fish into the lower Colorado River and its connective channels. The conservation measures associated with native fish augmentation were included in the HCP as part of the best practices for achieving successful conservation of native fishes in the lower Colorado River. Augmenting lower Colorado River fish populations embraces the strategy of replacing fish that are depleted due to natural mortality and high predation rates. Included in the augmentation total are goals to stock up to 330,000 razorback suckers into LCR MSCP River Reach 3 (Davis to Parker Dam) and 330,000 razorback suckers into River Reaches 4 and 5 (Parker to Imperial Dam). The demands for augmentation of this species can currently be met with the rearing capacity available to the program. Partner hatcheries and off-site rearing ponds have the annual capacity to produce approximately 20,000 razorback suckers greater than 12 inches long for augmentation. The future annual demand for augmentation of this species is scheduled to increase, and the LCR MSCP is developing additional rearing capacity to meet this need.

Monitoring and research are required components of the HCP (LCR MSCP 2004a) and are key elements of the LCR MSCP Adaptive Management Program. The intent of monitoring and research is to provide information for the adaptive management process so that the LCR MSCP can improve its effectiveness and efficiency in fulfilling the conservation goals associated with the fish augmentation program as described in the HCP (LCR MSCP 2004a). Research and monitoring efforts for the fish augmentation program fall into the following three general focus areas: 1) determining key environmental correlates affecting growth and survival during rearing, 2) understanding and minimizing adverse effects of transporting and stocking, and 3) understanding post-stocking distribution and survival. Stocking the appropriate number of native fishes into the lower Colorado River allows for the augmentation goals of the HCP (LCR MSCP 2004a) to be met; however, survival of these stocked fish is the simplest measure of conservation success. Survival rates are observed, recorded, and analyzed both during the rearing process and after fish are stocked. Regular monitoring through continuous sampling under the LCR MSCP, as well as annual interagency sampling efforts, will provide data on the populations of stocked fish. These data provide insight regarding the success of augmentation strategies and may alert resource agencies to new challenges in the future. These monitoring efforts are critical, and, in some form, are expected to continue throughout the 50-year term of the LCR MSCP.

4 LAND COVER AND SPECIES HABITAT MODELS

The 2004 HCP (LCR MSCP 2004a) and the 2004 BA (LCR MSCP 2004b) and used a habitat-based approach for compliance with Section 7(a)(2) and Section 10(a)(1)(B), respectively, of the ESA due to uncertainties in quantifying species impacts. To implement this approach, habitat models were developed

for the covered species and the results of the application of these models were used in the assessment of impacts.

Since most covered species' habitat had not been field delineated in the LCR MSCP planning area, habitat models were based on a land classification system developed by Anderson and Ohmart (1984) and Younker and Anderson (1986). This land classification system described three main land cover types used by LCR MSCP covered species. These are woody riparian land cover types (including cottonwood-willow and honey mesquite [*Prosopis glandulosa*]), marsh, and aquatic land cover.

Habitat models were developed for covered species whose habitats could be correlated to the physical and biological attributes associated with each of the LCR MSCP land cover types. The models define habitat for each covered species as the land cover types that would most likely encompass the elements of each covered species habitat, within the river reaches where each species was known to or may occur, based on known habitat requirements for the species. Additional information on the species habitat models can be found in Section 4.6.2.1 and is summarized in Table 4.9 in the 2004 BA (LCR MSCP 2004b).

The 2004 LCR MSCP effects analysis assumed that all (with a few noted exceptions) existing cottonwood-willow land cover that provided covered species habitat would be impacted by covered activities. These habitat losses are being fully mitigated under the 2004 HCP (LCR MSCP 2004a) and 2005 BO (USFWS 2005a). The two noted exceptions are 1) cottonwood-willow land cover at Topock Marsh, and 2) approximately 60 acres of cottonwood-willow land cover adjacent to the shore of Lake Havasu. Since flow-related covered activities will not affect Lake Havasu reservoir elevations, this habitat adjacent to Lake Havasu was not considered to be impacted by the 2004 changes in point of diversion, the 2022 increased reductions in flow, nor the proposed actions.

The original analysis excluded impacts to habitat for covered species at Topock Marsh due to avoidance and minimization measure AMM2. AMM2 states:

> AMM2—Avoid impacts of flow-related covered activities on covered species habitats at Topock Marsh. Impacts on groundwater levels that support covered species habitat at Topock Marsh will be avoided by maintaining water deliveries for maintenance of water levels and existing conditions. At times, flow-related activities could lower river elevations to levels that could disrupt diversion of water from the river to the marsh. Improvements to intake structures that allow water to continue to be diverted or other measures to maintain the water surface elevation will avoid effects on groundwater elevation. Avoidance of effects could be accomplished with the purchase, installation, and operation of two electric pumps sized to the current inflow at the Topock Marsh diversion inlet. The pumps would most likely need to be operated during summer to make up for the lower flow periods.
>
> Implementation of this conservation measure would maintain existing habitat at Topock Marsh for the Yuma clapper rail, southwestern willow flycatcher, Colorado River cotton rat, western least bittern, California black rail, yellow-billed cuckoo, gilded flicker, vermilion flycatcher, Arizona Bell's vireo, and Sonoran yellow warbler. The extent of covered species habitat impacts that will be avoided by maintaining water deliveries to Topock Marsh are presented in Table 4-2. Maintaining water deliveries to Topock Marsh will also maintain razorback sucker and bonytail habitat associated with disconnected backwaters managed for these species.

The LCR MSCP has fulfilled its obligations under AMM2 since the required funding was made available to the USFWS (USFWS 2012). Due to various circumstances, the project has not been fully completed, but completion is scheduled for 2025 or 2026 and will involve pumped delivery of water to Topock Marsh including during anticipated times of reduced flow and river stage. During the interim coverage period and prior to project completion, increased reductions in flow may affect USFWS ability to deliver

the required volume of water to fill Topock Marsh by the start of the breeding season (March 15). These impacts are analyzed in this BA but are temporary in nature until project completion and a conservation measure is proposed to offset this temporary impact.

Seven threatened and endangered species that use riparian woodland, marsh, and aquatic land cover types in Reaches 1 through 5 may be affected by additional reductions in flow coverage. These are the northern Mexican gartersnake, Yuma Ridgway's rail, southwestern willow flycatcher, western yellow-billed cuckoo, humpback chub, bonytail, and razorback sucker. Due to new information regarding the status of the humpback chub and razorback sucker in Reach 1 of the action area, effects to these species from the proposed action are also analyzed.

5 ENVIRONMENTAL BASELINE OF HABITAT

There have been minor changes to the marsh, backwater, and riverine habitat since the 2004 LCR MSCP analysis except for the creation of LCR MSCP conservation areas. The riparian habitat has experienced more substantial changes since the 2004 analysis including the creation of several LCR MSCP conservation areas. Local changes to riparian woodland habitats in the action area have occurred since 2004 as the result of several fires. Saltcedar-dominated habitats throughout the analysis area have been degraded as the result of defoliation and dieback caused by tamarisk leaf beetles (*Diorhabda carinulata*), which were present in Reach 2 in 2012 (personal communication, Tom Dudley, Research Biologist, University of California, Santa Barbara, to Mary Anne McLeod, Senior Biologist, SWCA, 2012) and had spread to the bottom of Reach 5 by 2020 (McLeod and Pellegrini 2021). Riparian woodland habitats have also changed notably as the result of the establishment of conservation areas, which are described below by reach. Table 5-1 shows the four LCR MSCP land cover types established by state and reach. Table 5-2 shows the land cover types established at each individual conservation area. Table 5-3 includes both the established and planned land cover for each conservation area. Figure 5-1 shows the location of established LCR MSCP conservation areas through FY22.

Table 5-1. Land Cover Type by Reach and State through FY22

	Cottonwood-Willow	Honey Mesquite	Marsh	Backwaters	Total
Arizona					
Reaches 1 and 2	0	0	0	0	**0**
Reach 3	516	0	0	0	**516**
Reach 4	1,305	808	255	0	**2,368**
Reach 5	0	0	13	80	**93**
Reach 6	1,162	129	94	0	**1,385**
Reach 7	43	0	0	0	**43**
Total	**3,026**	**937**	**362**	**80**	**4,405**
California					
Reaches 1 and 2	0	0	0	0	**0**
Reach 3	0	0	0	63	**63**
Reach 4	1,305	1,092	0	0	**2,397**
Reach 5	0	0	0	0	**0**
Reach 6	151	17	0	0	**168**
Reach 7	Not applicable (N/A)	N/A	N/A	N/A	**N/A**

	Cottonwood-Willow	Honey Mesquite	Marsh	Backwaters	Total
Total	**1,456**	**1,109**	**0**	**63**	**2,628**
Nevada					
Reaches 1 and 2	0	0	0	0	**0**
Reach 3	0	0	0	15	**15**
Reaches 4–7	N/A	N/A	N/A	N/A	**N/A**
Total	**0**	**0**	**0**	**15**	**15**
Total – All States	**4,482**	**2,046**	**362**	**158**	**7,048**

Table 5-2. Land Cover Type by Conservation Area through FY22

Land Cover Type	Management Unit		Total Established Acres
Cottonwood-Willow	E1	Beal Lake Conservation Area (Arizona)	120
	E4	Palo Verde Ecological Reserve (California)	945
	E5	Cibola Valley Conservation Area (Arizona)	457
	E21	Planet Ranch (Arizona)	396
	E24	Cibola NWR Unit #1 Conservation Area (Arizona)	848
	E27	Laguna Division Conservation Area (California and Arizona)	1,130
	E28	Yuma East Wetlands (Arizona)	183
	E31	Hunters Hole (Arizona)	43
	E39	Dennis Underwood Conservation Area (California)	360
Land Cover Type Total			**4,482**
Honey Mesquite	E4	Palo Verde Ecological Reserve (California)	324
	E5	Cibola Valley Conservation Area (Arizona)	808
	E27	Laguna Division Conservation Area (California and Arizona)	43
	E28	Yuma East Wetlands (Arizona)	103
	E33	Pretty Water Conservation Area (California)	566
	E36	Parker Dam Camp	80
	E39	Dennis Underwood Conservation Area (California)	122
Land Cover Type Total			**2,046**
Marsh	E9	Hart Mine Marsh (Arizona)	255
	E14	Imperial Ponds Conservation Area (Arizona)	13
	E28	Yuma East Wetlands (Arizona)	94
Land Cover Type Total			**362**
Backwater	E14	Imperial Ponds Conservation Area (Arizona)	80
	E25	Big Bend Conservation Area (Nevada)	15
	E35	Mohave Valley Conservation Area (California)	63
Land Cover Type Total			**158**
Total			**7,048**

Table 5-3. Acreage by Conservation Area through FY22

Conservation Area	Established Land Cover through FY22* (acres)	Total Planned Land Cover† (acres)	Total LCR MSCP Managed‡ (acres)	Total Conservation Area§ (acres)
Beal Lake Conservation Area (Arizona)	120	500	1,000	1,000
Big Bend Conservation Area (Nevada)	15	15	15	30
Cibola NWR Unit #1 Conservation Area (Arizona)	848	2,000	2,492	2,492
Cibola Valley Conservation Area (Arizona)	1,265	1,265	1,302	1,302
Dennis Underwood Conservation Area (California)	482	629	636	636
Hart Mine Marsh (Arizona)	255	255	266	266
Hunters Hole (Arizona)	43	43	43	43
Imperial Ponds Conservation Area (Arizona)	93	127	134	134
Laguna Division Conservation Area (Arizona and California)	1,173	1,173	1,173	1,173
Mohave Valley Conservation Area (California)	63	63	93	93
Palo Verde Ecological Reserve (California)	1,269	1,269	1,361	1,551
Parker Dam Camp (California)	80	80	204	204
Planet Ranch (Arizona)	396¶	458¶	1,320	3,427
Pretty Water Conservation Area (California)	566	566	566	566
Section 26 Conservation Area (California)	0	23	97	97
Three Fingers Lake (California)	0	245	673	673
Yuma East Wetlands (Arizona)	380	380	380	380
Yuma Meadows Conservation Area (California)	0	111	433	433
Total	**7,048**	**9,202**	**12,188**	**14,500**

* Acreage restored/protected as either the cottonwood-willow, honey mesquite, marsh, or backwater land cover type.

† Acreage already restored/protected or anticipated to be restored as a land cover type.

‡ Land within a conservation area managed by the LCR MSCP, including established/planned land cover and land not targeted for establishment.

§ Total acreage of the conservation area, including land managed by the LCR MSCP and land within the conservation area managed by the landowner.

¶ Includes protection of 396 acres of cottonwood-willow at the middle Bill Williams River NWR.

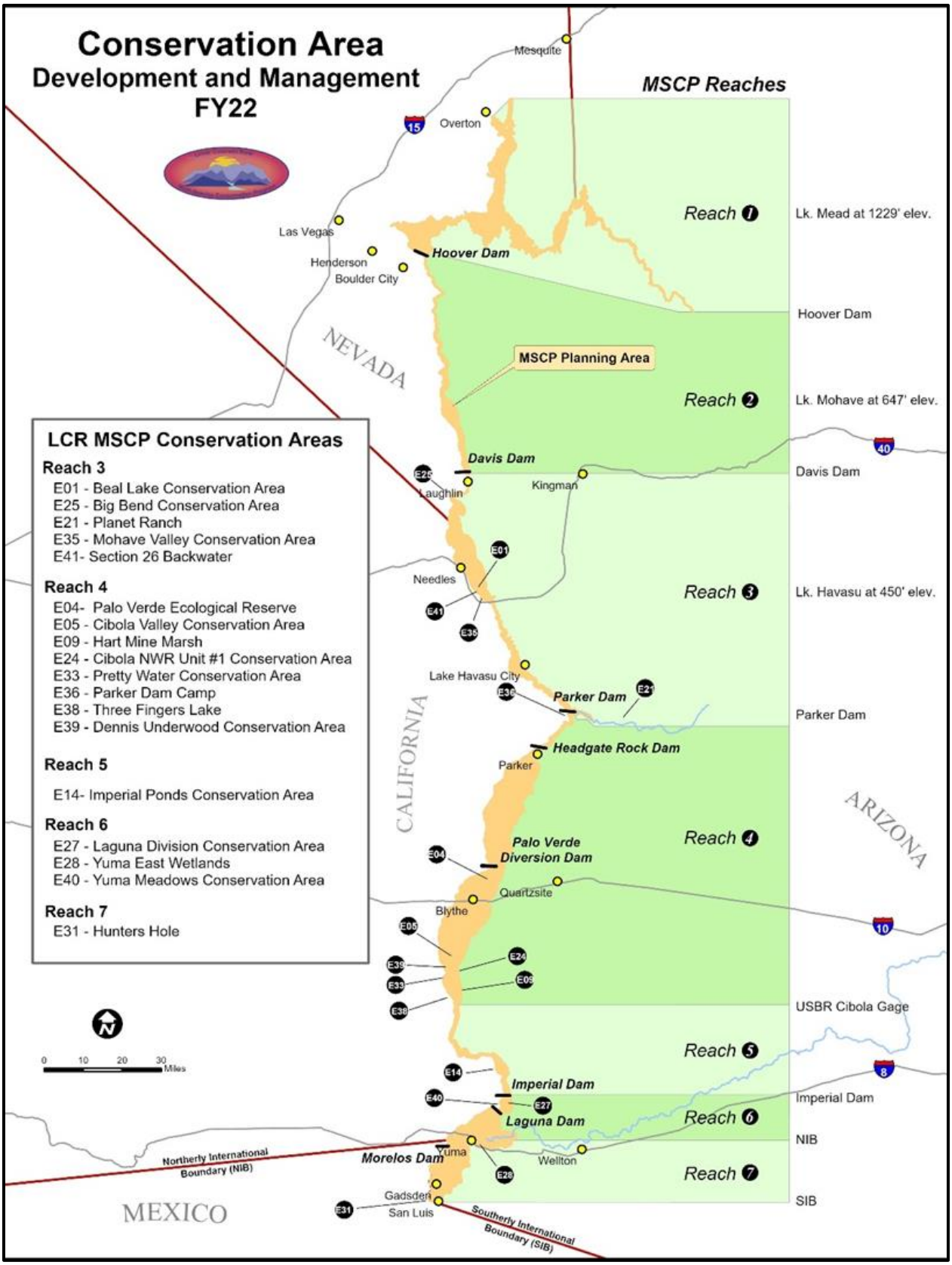


Figure 5-1. Established LCR MSCP Conservation Areas through FY22.

5.1 Reach 1

For the purpose of this BA, new information relating to an expansion of the humpback chub population from Grand Canyon will be considered. The humpback chub is not found in any other reach in the lower Colorado River. The proposed action will not substantially change the elevation of Lake Mead and that elevation is not predicted to drop below 950 feet; the purpose of the proposed action is to maintain and increase reservoir elevations in Lake Mead. However, the establishment of a new population of humpback chub in the Colorado River inflow to Lake Mead is new information with respect to the requirements of Section 7(a)2 of the ESA. Therefore, a species account and effects determination are provided for the action of reduced flows in the Colorado River and continued reduced elevation of Lake Mead that supports the new population. The following is an account of the new population in the inflow to Lake Mead.

A new population of humpback chub has become established at the inflow of the Colorado River into Lake Mead from Separation Canyon to Pearce Ferry (Rogowski et al. 2018; Van Haverbeke et al. 2017). This expansion of humpback chub began in about 2011 with a decline in lake elevation and the carving of a river channel in the deltaic deposits of the inflow that has provided about 40 miles of additional riverine habitat for the species. The estimated abundance of adult humpback chub in the newly carved channel (Separation Canyon to Pearce Ferry) is about 40,000 to 60,000 adults. A separate study estimates approximately 24,000 adult humpback chub between Diamond Creek and Pearce Ferry, but notes decreasing densities downstream of Separation Canyon (Van Haverbeke et al. 2022).

Approximately 0.5 mile downstream of Pearce Ferry is the Pearce Ferry Rapid. Relatively few humpback chub (< 30) have been captured or contacted downstream of the rapid each year since 2017 (Kegerries et al. 2017, 2018, 2019, 2021; Rogers et al. 2021, 2022). No upstream movement of marked native and nonnative fish species, including humpback chub, was detected from November 2020 through December 2022 (Fonken et al. 2023), when Lake Mead end-of-month elevations ranged from approximately 1,041 to 1,087 feet (Reclamation 2023). This suggests that the Pearce Ferry Rapid is a barrier to upstream fish movement at lower lake elevations, which benefits humpback chub upstream of the rapid by preventing upstream movement of nonnative piscivorous fishes from Lake Mead to the western Grand Canyon. The humpback chub is not a lake fish and is not expected to expand into Lake Mead proper or farther downstream.

The proposed action would not affect Lake Mead beyond the effects already analyzed in the original LCR MSCP. Although spawning habitat for razorback suckers has been periodically affected by changes in lake elevation over the last 18 years (2005–2022), razorback suckers have successfully moved their spawning locations to adjacent areas at progressively lower elevations as the lake receded and have moved back to previously used spawning locations in years when lake elevation increased (Albrecht et al. 2013). Elevation changes occur slowly throughout the spawning season and the remainder of the year, reducing the likelihood of other impacts such as stranding. Razorback sucker recruitment has been documented in Lake Mead every year from 2005 through 2020 despite changing reservoir elevations (Rogers et al. 2023). The purpose of the proposed action (reduction in flows in Reaches 2 through 5) is to increase storage (and reservoir elevations) in Lake Mead. This action would not create conditions outside of those observed in recent years and may be advantageous for successful recruitment by providing flooded terrestrial vegetation as additional cover for the young fish (Golden and Holden 2002; Welker and Holden 2003).

5.2 Reach 2

Habitat conditions in Reach 2 have not changed beyond what was predicted in the 2004 LCR MSCP analysis. Lake Mohave operations have remained consistent with the 1994 Memorandum (Reclamation 1994; see Section 8.2.1) and have not changed from the 2004 LCR MSCP environmental baseline. Although reductions in flow have occurred since 2004 within Reach 2 under the 2007 Colorado River Interim Guidelines for Lower Basin Shortages (Reclamation and Interior Department 2007) and the DCP, water level fluctuations have been managed according to the 1994 Memorandum, i.e., the elevation of Lake Mohave has not been lowered more than 2 vertical feet during any 10-day period from February through April (the razorback sucker spawning season). Managing the lake elevation in this way protects shallower razorback sucker spawning habitat and fertilized eggs from the effects of wave action or desiccation in lentic areas and provides adequate time for hatching of eggs in spring water temperatures should lake elevation need to be reduced. Lotic spawning habitat in the lake can be more affected by elevation changes due to its proximity to Hoover Dam, but adult razorback suckers have continued to find suitable spawning habitat in these areas throughout the spawning season, and over 74,000 larvae were captured from lotic habitat and delivered to hatcheries for rearing from 2019 through 2023.

5.3 Reach 3

Backwater habitat has not significantly changed since the 2004 LCR MSCP analysis with the exception of backwater habitat that has been established at the following conservation areas within the Colorado River floodplain between Davis and Parker Dams (Reach 3):

- The Big Bend Conservation Area is located south of Laughlin, Nevada, on land managed by the Nevada Division of State Lands. The Southern Nevada Water Authority acquired private upland property around an existing backwater to protect the backwater from development. This backwater was incorporated into the LCR MSCP as a conservation area, and the Southern Nevada Water Authority received an in-kind credit toward their funding obligations for the LCR MSCP on October 22, 2008 (LCR MSCP Decision Document 09-002). The 15-acre backwater is connected to the mainstem Colorado River and fluctuates with water releases from Davis Dam, which is approximately 4 miles upstream. The LCR MSCP is responsible for managing the backwater habitat by removing sediment on a periodic basis. Sedimentation from stormwater runoff has degraded a portion of this habitat. The LCR MSCP will complete maintenance dredging to restore the open water component of this conservation area.
- Beal Lake at the Beal Lake Conservation Area is a 225-acre backwater that was originally identified as one of three impoundments for native fish habitat under the 1997 *Biological and Conference Opinion on Lower Colorado River Operations and Maintenance—Lake Mead to Southerly International Boundary* (USFWS 1997). Beal Lake was recently dredged in FY21 to enhance habitat for the benefit of native fishes by providing additional depth for thermal refuge and refuge from predators. Continued management of Beal Lake is required under the 2005 BO (USFWS 2005a).
- Mohave Valley Conservation Area is within Moabi Regional Park, approximately 13 miles south of Needles, California. Reclamation entered into a lease with the California State Lands Commission to create a 63-acre backwater that is directly connected to the Colorado River. Water control structures are used to maintain water elevations when river flows are low.
- Section 26 Conservation Area will be a 23-acre backwater with a direct connection to the lower Colorado River. This conservation area is currently under construction and dredging is expected to be completed by FY 2025. The target elevation for the inlet canal and backwater is consistent

with the elevation of the river bottom to ensure the backwater remains connected under variable flows. Water surface elevations in the backwater will fluctuate with river stage.

Riparian woodland habitat has been established at the following conservation area in Reach 3:

- The Beal Lake Conservation Area is located adjacent to Topock Marsh on the Havasu NWR. The Beal Lake Conservation Area contains 120 acres of cottonwood-willow vegetation. Water needed for irrigation of established cottonwood-willow habitat, as well as for Beal Lake itself, is supplied from Topock Marsh using the USFWS water entitlement for Havasu NWR. The HCP (LCR MSCP 2004a) requires the federal participants and non-federal permittees to avoid impacts of flow-related covered actions and activities on covered species habitat at Topock Marsh (LCR MSCP 2004a:Section 5.6.1-AMM2). Reclamation entered into an agreement to provide funding to the USFWS to design and construct a new water delivery system for Topock Marsh to complete avoidance and minimization measure AMM2 and received a letter from the USFWS on July 2, 2012, stating that no further action was required to meet the obligations of AMM2.

Riverine spawning habitat for razorback suckers is present in Reach 3. Six in-channel spawning locations have been identified and are monitored monthly during the spawning season (January–May). Despite daily fluctuations in river stage throughout the spawning season, razorback sucker larvae were present at targeted sampling locations in recent years (Bullard et al. 2019, 2022; Bullard and Best 2022). This suggests that not all spawning habitat is affected by these fluctuations, or other suitable spawning habitat is available at different river stages. Cross-sectional information is provided (see Section 3.7.1.4 and 10.6.2; see Attachment 1), and the effects of reduced flow on spawning habitat is evaluated.

Flathead catfish (*Pylodictis olivaris*) have been present in the lower Colorado River since the early 1960s (Botroff et al. 1969, as cited in Young and Marsh 1990). They were first observed in Lake Havasu in the 1980s, and were found throughout Topock Gorge by 2015, with captures occurring upstream to Pulpit Rock (river mile 229) (Ehlo 2023). More recent surveys resulted in the capture or visual identification of 50 flathead catfish as far upstream as river mile 255.

5.4 Reaches 4 and 5

Reaches 4 and 5 are grouped in the analysis because there are no storage dams separating the two reaches.

Marsh and backwater habitats have been established at the following conservation areas and managed habitat areas between Parker and Imperial Dams (Reaches 4 and 5):

- Hart Mine Marsh is at the south end of the Cibola NWR, approximately 15 miles south of Blythe, California. Hart Mine Marsh contains approximately 255 acres of marsh habitat. Water is supplied to Hart Mine Marsh from Arnett Ditch and from the Colorado River via the water conveyance infrastructure in Cibola NWR's Unit 2 management area.
- Cibola High Levee Pond is on the Cibola NWR, approximately 5 miles south of Palo Verde, California. Cibola High Levee Pond is an approximately 5-acre backwater that provides habitat for native fishes. The pond is hydrologically connected to the river through a porous levee. Water exchange occurs by gravity and the flow of the river.
- Imperial Ponds Conservation Area is on the Imperial NWR, north of Yuma, Arizona. Six backwaters provide approximately 80 acres of habitat. The backwaters have a water delivery system that is supplied by well water. The Imperial Ponds Conservation Area also has 13 acres of marsh habitat.

Riparian woodland habitat has been established at the following conservation areas in Reaches 4 and 5:

- Palo Verde Ecological Reserve is located approximately 8 miles northeast of Blythe, California. This conservation area has 945 acres of cottonwood-willow habitat. Water is supplied from the Palo Verde Irrigation District, which has an entitlement to Colorado River water.
- Cibola Valley Conservation Area is located approximately 15 miles south of Blythe, California. This conservation area has 457 acres of cottonwood-willow habitat and receives water from multiple fourth, fifth, and sixth priority water entitlements.
- Cibola NWR Unit #1 is located approximately 17 miles south of Blythe, at the north end of the Cibola NWR. This conservation area has 848 acres of cottonwood-willow habitat and receives water from Cibola NWR's second priority water entitlement.
- Dennis Underwood Conservation Area is approximately 18 miles south of Blythe, California. This conservation area has 360 acres of cottonwood-willow habitat. Water is supplied from the Palo Verde Irrigation District, which has an entitlement to Colorado River water.

Spawning habitat for razorback suckers is present in Reach 4. Two spawning locations, one in-channel and one backwater, have been identified and are monitored monthly during the spawning season (January–May). Cross-sectional information is provided, and the effects of reduced flow are evaluated for these locations.

6 PROPOSED ACTION AND ACTION AREA

As stated in Section 2, Reclamation is requesting consultation on the following actions: 1) increasing the amount of reduction in flow coverage provided under the LCR MSCP in Reaches 2 through 5 (from Hoover Dam to Imperial Dam) in the range of 2.083 to 3.0 mafy, from the current coverage of 1.574 mafy; and 2) implementing proposed conservation measures, including minimization measures, additional monitoring and research, and habitat creation as an integral part of the proposed action to fully offset the potential effects on species and their habitats associated with the requested increases in flow reductions. Reduction in flow up to 2.083 mafy is the proposed base action while reduction in flow in excess of 2.083 mafy and less than 3.0 mafy is the proposed expanded action. These actions are described in more detail in Sections 6.1 and 6.2.

Reclamation is in the process of preparing an SEIS to modify the 2007 *Record of Decision—Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead* (Reclamation and Interior Department 2007) in accordance with NEPA regulations. The purpose and need of the SEIS are to address the potential for continued low-runoff conditions in the Colorado River Basin. Reclamation has concluded that the potential impacts of low runoff conditions in the coming years pose unacceptable risks to the routine operations of Glen Canyon and Hoover Dams during the interim SEIS period (prior to January 1, 2027) and accordingly, modified operating guidelines need to be expeditiously developed. Reclamation envisions that these modified guidelines could include reductions in releases from Hoover Dam up to 3.0 mafy during this interim SEIS period and during the first years of implementation of Colorado River Post-2026 Operations. One of the unacceptable risks during this interim coverage period is the possibility of Lake Mead reaching dead pool, at which point no water would be able to be released from Hoover Dam. Reaching dead pool and not being able to release water from Hoover Dam would have catastrophic effects on listed species. The proposed action is intended to avoid reaching this point.

While the proposed action in this BA is primarily directed at this interim SEIS period, Reclamation initiated the NEPA process to address long-term Colorado River operations (i.e., post-2026) in June 2023.

In concert with the NEPA process, Reclamation will collaborate with the USFWS on additional long-term compliance under the ESA and, when appropriate, will re-initiate formal consultation. In preparation for the future consultation, this BA proposes several monitoring and research measures that will allow Reclamation and the USFWS to perform a more thorough and accurate impact analysis for the future proposed action. These data will also be used to inform the proposed conservation strategy that will be developed as part of this future consultation.

Figure 6-1 illustrates the reaches of the river within the LCR MSCP planning area. Figure 6-2 shows the footprint of the LCR MSCP planning area for Reaches 1 through 5, which is considered the action area under this consultation. There are no new effects in Reaches 6 and 7, and so they are not included in Figure 6-2. See Attachment 3 for an explanation of why there are no new effects in these reaches.

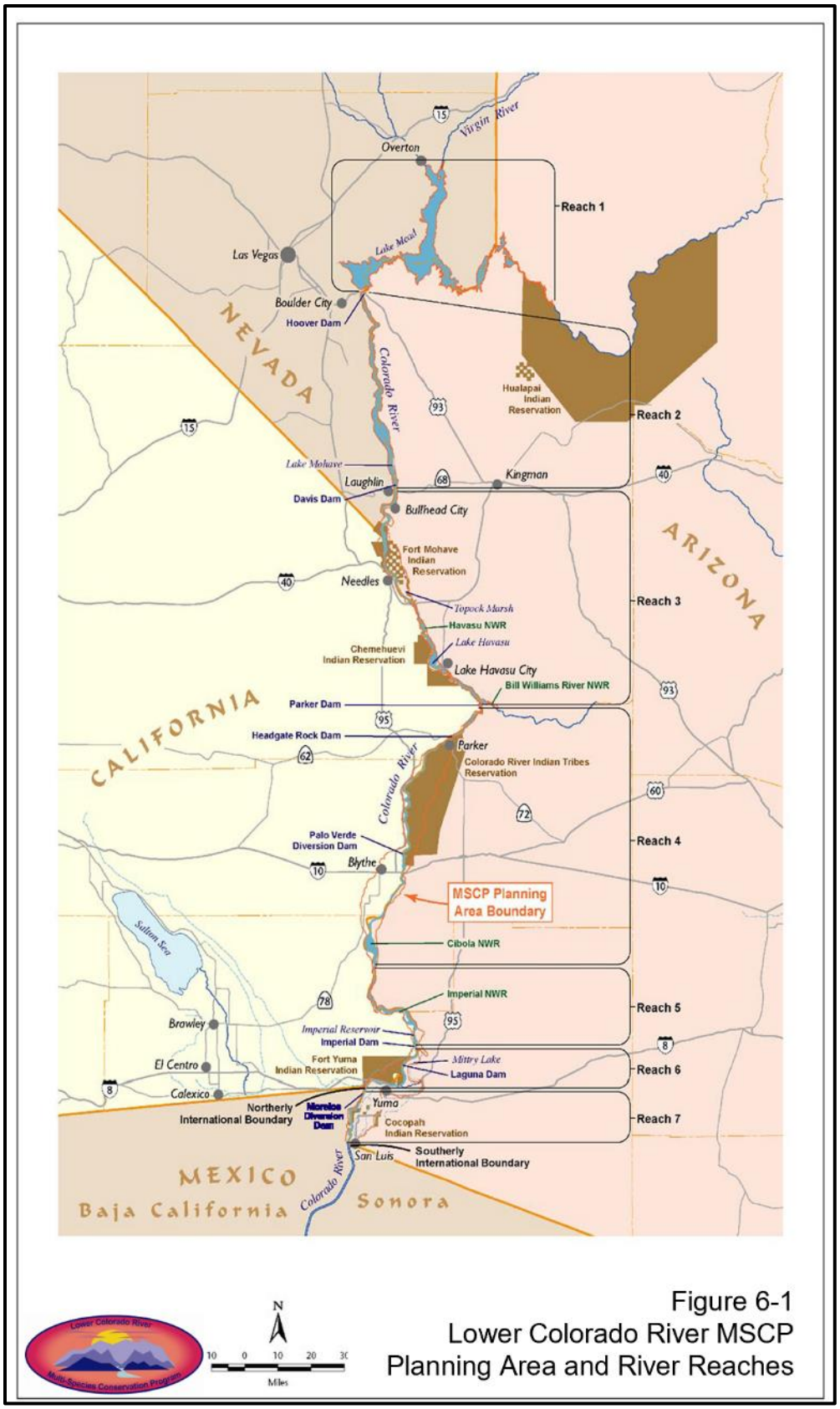


Figure 6-1. Lower Colorado River MSCP Planning Area and River Reaches.

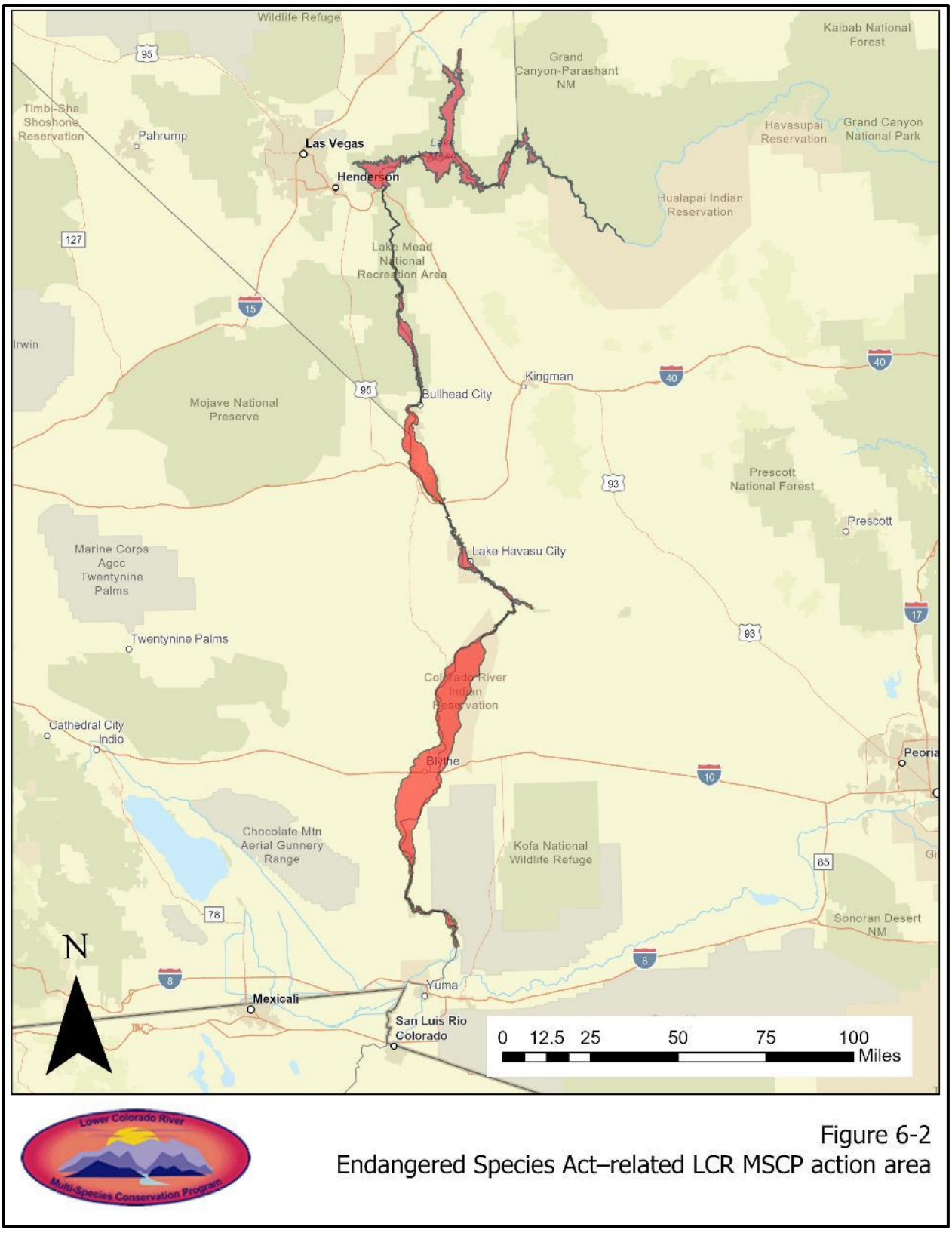


Figure 6-2. Endangered Species Act–related LCR MSCP action area.

6.1 Proposed Base Action

The proposed base action is defined as annual reductions in flow up to 2.083 maf in Reaches 2 through 5 (from Hoover Dam to Imperial Dam) for the period ending on January 31, 2028 or until issuance of a new BO to cover new or revised Colorado River Post-2026 Operations, whichever occurs sooner. The base action and its associated, modeled impacts include the assumption that all proposed reductions in flow are implemented at the same time, immediately following issuance of the BO even though reductions in flow of this magnitude may not occur every year throughout the interim coverage period.

The proposed base action reduction in flow described herein (up to 2.083 mafy) relates to, but is not the same as, the water conservation action contemplated in the SEIS prepared for the 2007 Interim Guidelines (Reclamation and Interior Department 2007). The proposed NEPA-specific action that is analyzed in the SEIS includes system water conservation actions totaling 3.0 maf through 2026 with a minimum of 1.5 maf physically conserved by the end of calendar year 2024 (these conservation actions are collectively termed SEIS Conservation). The SEIS Conservation is in addition to tier-based reductions and contributions in accordance with the 2007 Interim Guidelines, the Lower Basin DCP, and Minute 323.[11] The 3.0 maf of additional conservation is not tier-based and would be implemented regardless of Lake Mead elevations. A distinction between the proposed base action volume and the SEIS Conservation volume is that the proposed base action volume is for an annual period whereas the SEIS Conservation volume refers to a cumulative time period (ultimately through 2026) and is not necessarily for an annual period. Another distinction is that some SEIS Conservation, such as water conservation that occurs above Hoover Dam, may not result in reductions in flow below Hoover Dam.

The base action proposed under this consultation is designed to provide sufficient ESA coverage for implementation of the SEIS proposed action, i.e., implementation of system conservation totaling 3.0 maf through 2026 in accordance with the Lower Basin Plan, continued implementation of the 2007 Interim Guidelines including tier-based shortage, continued tier-based contributions in accordance with the DCP, and reductions associated with the initial years of implementation of Colorado River Post-2026 Operations. Table 6-1 shows the maximum annual reduction in flow as 1.850 maf with the assumption that 750,000 af of SEIS Conservation is implemented each year. The proposed base action provides operational flexibility for the SEIS proposed action since the timing of the SEIS Conservation is expected to vary from year to year. The proposed base and expanded actions also allow for sufficient flexibility if additional Minutes to the 1944 Treaty are adopted that result in federal discretionary flow-related activities since the resulting reduction in flow volumes would need to be included in the proposed base action.

Based on mid- to long-term hydrologic projections, Reclamation has concluded that it is relatively certain there will be future hydrologic situations out to 2055 where increased reductions in flow up to 2.083 mafy will be necessary to prevent Lake Mead from declining to critically low levels. It is for this reason that Reclamation is requesting coverage greater than 1.574 mafy, up to 2.083 mafy. Additionally, Reclamation is committing to habitat creation conservation measures to be implemented for the remaining term of the LCR MSCP (2055). At this time, the Reclamation, State, and Service partners plan to work toward meeting their ESA regulatory responsibilities for the new Post-2026 Colorado River Operational Guidelines. Reclamation requests that due consideration and credit be given for conservation measures outlined in current LCR MSCP guiding documents, and the conservation measures proposed in this BA for the duration of the program (2055).

[11] Water delivery reductions under low elevation reservoir conditions, water savings under the Binational Water Scarcity Contingency Plan, and water conservation in accordance with Minute 323 are not considered to be Reclamation discretionary actions, but anticipated domestic impacts from these actions are included for use in analysis under the ESA.

Table 6-1. Lower Division States' Shortages, DCP Contributions, and SEIS Conservation for the Proposed Action (2023–2026)

Lake Mead Elevation (feet)		Existing Reductions and Contributions			Proposed Action	
Minimum	Maximum	2007 Interim Guideline Shortages (1,000 af)	2019 DCP Contributions (1,000 af)	No Action Total (1,000 af)	SEIS Conservation (1,000 af)	Total Interim Guideline Shortages + DCP Contributions + SEIS Conservation (1,000 af)*
1,090	>1,075	0	200	200	Approximately 750 annually*	**950**
1,075	1,050	333	200	533		**1,283**
<1,050	>1,045	417	200	617		**1,367**
1,045	>1,040	417	450	867		**1,617**
1,040	>1,035	417	500	917		**1,667**
1,035	>1,030	417	550	967		**1,717**
1,030	1,025	417	600	1,017		**1,767**
<1,025	1,000	500	600	1,100		**1,850**
<1,000	975	500	600	1,100		**1,850**
<975	950	500	600	1,100		**1,850**
–	<950	500	600	1,100		**1,850**

* The amount of SEIS conservation could be higher or lower in a given year depending on the conservation agreements in place that year.

6.2 Proposed Expanded Action

Due to the uncertainty regarding the precise timing of the SEIS Conservation and other circumstances that may influence operations during the interim coverage period (i.e., through January 31, 2028 or until issuance of a new BO to cover new or revised Colorado River Post-2026 Operations, whichever occurs sooner), Reclamation is including a proposed expanded action for reductions in flow greater than 2.083 mafy up to 3.0 mafy. The probability of reductions in flow being greater than 2.083 mafy are low between now and 2028, but certain circumstances[12] could necessitate these increased reductions. Since the proposed expanded action is unlikely to occur and considerably less probable to occur for multiple years during the interim coverage period, Reclamation is proposing that conservation measures to mitigate the impacts of the proposed expanded action only be required if the proposed expanded action occurs during the interim coverage period, i.e., reductions in flow exceed 2.083 maf in a given year during the interim coverage period. The conservation measures associated with the proposed expanded action are short-term measures designed to avoid and minimize the effects of the proposed expanded action during the interim coverage period. Short-term monitoring and research conservation measures (included under the proposed base action) will consider and analyze long-term measures that could offset the long-term effects of the proposed expanded action if similar magnitudes of reduction in flow are included in future consultations.

[12]Hydrologic scenarios that allow individual states to conserve additional water in addition to what is included in the SEIS Conservation volume. If a potential new Minute under negotiation to the 1944 Water Treaty is adopted that results in Reclamation discretionary flow-related activities, the resulting reduction in flow volumes would need to be included in the proposed expanded action.

6.3 Relationship and Process Regarding the Base vs Expanded Action

Reclamation currently hosts monthly meetings with non-federal permittees in accordance with the "White Paper Clarifying Flow Related Activities during Water Year 2019." This document was prepared in response to discrepancies in the draft and final accounting numbers contained in Attachment B, Description of Take to the *Lower Colorado River Multi-Species Conservation Program Final Implementation Report, Fiscal Year 2021 Work Plan and Budget, Fiscal Year 2019 Accomplishment Report* (LCR MSCP 2020b). The purpose of these monthly meetings is to:

- discuss and coordinate operational and other water management issues that arise during the year,
- discuss LCR MSCP compliance issues, and
- discuss and track reductions in flow to ensure there is sufficient time to adjust water orders and other operations to stay within the limits outlined in the 2005 (USFWS 2005a), 2022 (USFWS 2022), and subsequent BOs.

In the context of this consultation, these meetings will be used to determine if there is a need to transition from the proposed base action to the proposed expanded action. If any monthly status report shows that the predicted reduction in flow exceeds 2.083 maf for the current water year, Reclamation and the non-federal permittees will discuss the need for exceeding the base action, if there is discretion in exceeding the base action, and the benefits and consequences of exceeding the base action if deemed discretionary. Reclamation and the non-federal permittees will then decide if transition to the expanded action will occur. If the decision is made to transition to the expanded action, Reclamation will send a letter to the USFWS notifying them that the covered activity is transitioning from the base to the expanded action. This letter will contain details on how Reclamation intends to implement the conservation measures associated with the expanded action. Once the transition to the expanded action is complete, Reclamation will continue to fulfill all conservation measures associated with the expanded action until January 31, 2028, or until issuance of a new BO to cover new or revised Colorado River Post-2026 Operations, whichever occurs sooner.

6.4 Conservation Measures

The following conservation measures were identified during Reclamation's environmental impact analysis of the proposed action. The measures are hereby incorporated into the proposed action for Section 7 consultation to avoid, minimize, and/or mitigate anticipated impacts to listed species.

6.4.1 Base Action Conservation Measures

6.4.1.1 LONG-TERM CONSERVATION MEASURES

The following long-term conservation measures will be incorporated through 2055:

2024CLRA1 – Create 41 acres of Yuma Ridgway's rail habitat. Create, monitor, and adaptively manage 41 acres of marsh to provide habitat for the Yuma Ridgway's rail. This created habitat will also provide habitat for the northern Mexican gartersnake. Habitat will be created in patches that are as large as possible but will not be created in patches smaller than 5 acres. Smaller patches are likely to support isolated nesting pairs and be within the range of habitat patch sizes used by the species for foraging and dispersal. Larger patches would be expected to support multiple nesting pairs. Additional Yuma Ridgway's rail habitat may be provided by marsh vegetation that becomes established along margins of

the backwaters that will be created under the LCR MSCP. These small patches of habitat would provide cover for dispersing Yuma Ridgway's rails, thereby facilitating linkages between existing breeding populations and the colonization of created habitats.

Yuma Ridgway's rail habitat will be created and maintained as described in Section 5.4.3.3 of the 2004 BA (LCR MSCP 2004b). Marshes created to provide Yuma Ridgway's rail habitat will be designed and managed to provide an integrated mosaic of wetland vegetation types, water depths, and open water areas. Within this mosaic of marsh conditions, Yuma Ridgway's rail habitat will generally be provided by patches of bulrush and cattails interspersed with small patches of open water with water levels maintained at depths appropriate for this species. Created marsh habitat will generally be managed to provide for gradual fluctuations in water level during Yuma Ridgway's rail breeding season (March–June).

2024NMGS1 – Create 41 acres of northern Mexican gartersnake habitat. Create and manage 41 acres of marsh to provide northern Mexican gartersnake habitat. This created habitat will also be habitat for the Yuma Ridgway's rail. Newly created habitat will be located near existing conservation areas. Additional northern Mexican gartersnake habitat may be provided by marsh vegetation that becomes established along margins of backwaters that will be created under the LCR MSCP. These small patches of habitat may provide linkages between existing habitat and may facilitate the colonization of created habitats. Marsh associated with backwaters that are disconnected from the lower Colorado River channel are of higher value to the northern Mexican gartersnake than are connected backwaters on the lower Colorado River and are the preferred type to achieve LCR MSCP conservation goals for this species. Marsh associated with disconnected backwaters are managed to limit nonnative predatory species, to the extent practicable. The design and management criteria described in the conservation measures for Yuma Ridgway's rail, California black rail, southwestern willow flycatcher, and western yellow-billed cuckoo (see Sections 5.7.1, 5.7.13, 5.7.2, and 5.7.14, respectively, of the 2004 HCP [(LCR MSCP 2004a]) will ensure that the created cottonwood-willow and marsh areas will also provide other habitat requirements for this species.

2024RASU2 – Create 109 acres of razorback sucker habitat. Create 109 acres of disconnected backwater with water depth, vegetation, and substrate characteristics that provide the elements of razorback sucker habitat. This created backwater will also provide habitat for the bonytail. Created backwaters will be designed and managed as described in Section 5.4.3.4 of the 2004 HCP (LCR MSCP 2004a). At a minimum, created backwaters will contain the physical, chemical, and biological conditions suitable for the establishment and maintenance of healthy fish populations.

2024BONY2 – Create 109 acres of bonytail habitat. Create 109 acres of disconnected backwater with depth, vegetation, and substrate characteristics that provide the elements of bonytail habitat. This created backwater will also provide habitat for the razorback sucker. Created backwaters will be designed and managed as described in Section 5.4.3.4 of the 2004 BA (LCR MSCP 2004b). At a minimum, created backwaters will contain the physical, chemical, and biological conditions suitable for the establishment and maintenance of healthy fish populations.

6.4.1.2 SHORT-TERM CONSERVATION MEASURES

The following short-term conservation measures will be incorporated through 2026 or until a new post-2026 BO is issued:

2024RASU7[13] – Provide funding and support for continuation of the ongoing Lake Mead razorback sucker studies. The LCR MSCP will continue to fund and support the ongoing studies of razorback suckers in Lake Mead that were implemented under the BO for Interim Surplus Criteria and Secretarial Implementation Agreements. These studies were continued under conservation measure RASU7 in the 2004 HCP (LCR MSCP 2004a). Continuation of these studies will take place throughout the interim coverage period. Data collected during this period will be analyzed and used to inform the post-2026 consultation, future conservation strategies, and future data collection efforts. The focus of the studies will be to resolve any remaining questions about the location of populations of razorback suckers in Lake Mead from the lower Grand Canyon (Separation Canyon) area downstream to Hoover Dam, documenting use and availability of spawning areas at various water elevations, clarifying substrate requirements, monitoring potential nursery areas, continuing ageing studies, and confirming recruitment events that may be tied to physical conditions in the lake. These studies may be followed by further research and monitoring within the adaptive management program of the LCR MSCP.

2024HUCH1 – Provide additional funding to support existing humpback chub conservation programs. The LCR MSCP will continue to make available funding reserved under HUCH1 in the HCP (LCR MSCP 2004a) to the Glen Canyon Dam Adaptive Management Program or other entity approved by the USFWS to support implementation of planned, but unfunded, species conservation measures and, as appropriate, to fund species conservation measures in the lower Grand Canyon of the Colorado River upstream of Lake Mead National Recreation Area. The LCR MSCP will also make available an additional $75,000 to support the research and monitoring needed to better understand the population dynamics of humpback chub in the lower Grand Canyon downstream of Separation Canyon and research to better understand the movements of nonnative species from below Pearce Ferry Rapid into the Grand Canyon.

2024BONY5 – Conduct monitoring and research, and adaptively manage bonytail augmentations and created habitat. This conservation measure is a new research effort that will build upon the work completed under BONY5 in the HCP (LCR MSCP 2004a) with a specific focus on High Levee Pond at the Cibola National Wildlife Refuge. Funding will be provided to the USFWS to carry out monitoring and research at High Levee Pond. The monitoring and research will be conducted to gather information necessary to adaptively manage bonytail conservation, including aggressive monitoring of fish response following augmentations to gather information regarding habitat use and fish movement, to increase the success of subsequent management of the species.

2024AMM1 – Minimize the impacts of reduced river stage on covered species habitats at Topock Marsh due to delayed completion of projects related to full implementation of AMM2. Prioritize water deliveries to the Willow Marsh at Beal Lake Conservation Area and postpone any potential habitat disturbances in this known northern Mexican gartersnake habitat. Pump water from Topock Marsh to flood irrigate existing cottonwood-willow patches occupied by northern Mexican gartersnakes and breeding southwestern willow flycatchers along the edge of the marsh to maintain the quality and quantity of this habitat if Topock Marsh elevations drop during spring and summer due to reduction or delays in water deliveries.

[13] Conservation Measure RASU7 in the 2004 HCP (LCR MSCP 2004a) anticipated that ongoing studies would be completed in 5 to 10 years. The LCR MSCP has continued these activities beyond the anticipated completion date and has fulfilled the commitments as envisioned in the original conservation measure. This proposed conservation measure, 2024RASU7, is a new conservation measure being proposed to augment the knowledge gained from these past efforts and to inform future consultations.

2024MRM1 – Develop procedures to increase the accuracy of measuring impacts to habitat caused by flow-related covered activities. Reduction in flow downstream of Hoover Dam, which may be caused by changes in the point of diversion or changes in storage in Lake Mead, is currently used as a surrogate for measuring impacts to species habitat. The LCR MSCP will conduct research to determine if there is a more accurate way of measuring habitat impacts caused by flow-related covered activities.

2024MRM2 – Collect necessary data needed for future consultations and update existing methodologies with new information. The 2007 Interim Guidelines (and other associated agreements) expire at the end of 2026. At that time, Reclamation will be required to consult with the USFWS on the new federal action. Due to changes since the establishment of the LCR MSCP, it will be necessary to have updated information for this next consultation. The following items will be needed to properly analyze impacts in the next consultation:

1. Hydrologic modeling inputs: New bathymetry has been collected for the entire lower Colorado River. A new HEC-RAS[14] model has been proposed that would allow for more accurate modeling. The current impacts model predicts the river stage at discrete locations where a cross section was conducted. A new HEC-RAS model, using recently collected continuous bathymetry, would be able to predict the river stage along the entire stretch of the river. This would result in more accurate modeled water surfaces and predictions of impacts to existing marsh and backwater habitat.
2. Vegetation classification: The impacts analyses performed to date have all used a vegetation classification conducted in 1997. The LCR MSCP will complete a basin-wide vegetation classification using recently collected imagery that will be used to update the environmental baseline and conduct an updated impact analysis.
3. Backwater mapping: The impacts analyses performed to date have all used backwater mapping conducted in 2000. The LCR MSCP will complete a basin-wide backwater mapping using recently collected data (remote sensing and bathymetry) that will be used to update the environmental baseline and conduct an updated impact analysis.
4. Marsh bird presence: The LCR MSCP has conducted marsh bird surveys in portions of Topock Gorge since 2005 providing a data set for over two decades under Work Task D1: Marsh Bird Surveys. If the USFWS deems it valuable to continue this data collection for the next consultation or for their Yuma Ridgway's rail recovery plan, the LCR MSCP could commit to continuing collection of data for this long-term data set or possibly expand the survey points as appropriate.
5. Dam operations: Due to the changing energy portfolio in the Southwest, operations of lower Colorado River dams have changed over the last 20 years. The impacts analyses performed to date have all used dam release schedules based on operating criteria from the early 2000s. Future impact analyses will use updated release schedules based on current operating criteria. These release schedules would be updated for use in other components of the impact analysis model.
6. Modeling assumptions: Several assumptions used in the impact analysis model were used in the previous impacts analyses performed to date. These assumptions will be reviewed and updated as necessary to improve the impact analysis.

2024MRM3 – Conduct research on northern Mexican gartersnake habitat use. Little is known about the spatial and temporal use of habitat by the northern Mexican gartersnake on the lower Colorado River. To better evaluate the impacts in future consultations, additional presence data will be collected. This additional information will assist the LCR MSCP in designing, creating, and managing northern Mexican

[14] HEC-RAS is the U.S. Army Corps of Engineers River Analysis System developed by the Hydrologic Engineering Center.

gartersnake habitat. Surveys would be conducted in select areas within the geographic boundary of the LCR MSCP planning area with suitable northern Mexican gartersnake habitat conditions.

2024MRM4 – Synthesize native fish data to inform future fish augmentation efforts and native fish habitat creation. The HCP (LCR MSCP 2004a) requires that the LCR MSCP use the adaptive management process to guide implementation of the program. Sufficient data from alternative stocking now exist that could be used to propose changes in the current native fish augmentation strategy, but these data have yet to be synthesized. Synthesis of all native fish stocking and contact data will be completed to inform future stocking strategies. Data will also be synthesized on habitat use to inform habit creation and manipulation of existing habitat. Additional components of this data synthesis will include, but are not limited to 1) feasibility analysis of stocking native fish in other existing reservoirs that currently do not receive native fish stockings, 2) identification of existing backwaters on the lower Colorado River that might be suitable for native fish stocking and subsequent management as native fish habitat, and 3) feasibility analysis and needs determination of renovation, rehabilitation, and upgrade of existing backwaters to ensure their continued viability as functional habitat under reduced flow scenarios, 4) evaluate the value to native fishes of disconnected versus connected backwaters, and 5) evaluate the value that the habitat diversity of connected backwaters provides in highly modified river stretches with armored banklines and constructed levees. The LCR MSCP will collaborate with the Service throughout the development of this data synthesis. Results of and conclusions drawn from the synthesis will be given strong consideration in crafting future or adjusted conservation measures.

2024MRM5 – Conduct a feasibility analysis for the construction of disconnected backwaters outside of the LCR MSCP implementation area. The 2005 Record of Decision for the LCR MSCP identified off-site locations for implementing the Conservation Plan that were outside the LCR MSCP planning area. Reclamation would work with the USFWS and other partners to determine if it is feasible to implement certain elements of the Conservation Plan at additional off-site locations.

6.4.2 Expanded Action Conservation Measures

All expanded action Conservation Measures are considered short-term and will be in effect if the expanded action has been triggered and will only be continued through January 31, 2028, or until the issuance of a new BO to cover new or revised Colorado River Post-2026 Operations, whichever occurs sooner.

2024AMM2 – Minimize the potential for stranding of native fishes due to reduced river stage. Ensure that backwaters created and managed by the LCR MSCP (Big Bend, Mohave Valley, Section 26, and Imperial Ponds Conservation Areas) will have sufficient water and/or will maintain connectivity to the mainstem during periods of low river stage. Big Bend is a connected backwater scheduled for maintenance dredging and, when completed, would provide sufficient water depths. Mohave Valley and Section 26 are connected backwaters and should have sufficient water to maintain connectivity to the mainstem during periods of low river stage. At Imperial Ponds, water is delivered from groundwater wells to maintain disconnected backwaters and, if necessary, the pumping cycle can be increased. If there is any risk of complete disconnection or not being able to maintain adequate water quality for sustaining healthy fish, the following tasks will be completed:

1. Water quality and quantity will be monitored to assess if sufficient water and adequate water quality is present.
2. If water quality or quantity decline, pumps will be mobilized to ensure sufficient water is supplied to the backwater and that adequate water quality is sustained.
3. If water quality or quantity declines further, fish will be rescued and transported to an LCR MSCP–managed backwater or another mainstem backwater that has stable connectivity and

adequate water quality. A protocol will be developed that will include health assessments to ensure that diseased fishes are not introduced into healthy populations. The protocol will also include procedures to ensure that nonnative fishes are not introduced into nonnative free populations.

2024AMM3 – Minimize the impacts of reduced river stage on entrained or stranded native fishes. Monitor key backwaters not created by the LCR MSCP (e.g., CHLP), off-channel infrastructure, and known spawning locations for entrained or stranded fish. Perform rescue efforts as needed. Work with partner agencies as needed to educate them on 1) identifying areas prone to entrainment or stranding and 2) procedures for rescuing entrained or stranded fish. If water quality or quantity decline, pumps will be mobilized to ensure sufficient water is supplied to the backwater and that adequate water quality is sustained.

2024AMM4 – Minimize the impacts of reduced river stage on fish augmentation activities. Timing and location of stocking events will be adjusted to ensure fish are released when the river stage will be sufficiently high for the critical post-stocking survival period or stocked into riverine sections or reservoirs where fluctuations in water surface are minimal.

2024AMM5 – Enhance northern Mexican gartersnake, Yuma Ridgway's rail, southwestern willow flycatcher habitat at Planet Ranch. Use all or a portion of the annual water entitlement (5,549 af) at Planet Ranch to provide water to potential habitat downstream (Figure 6-3) of the constructed backwaters using existing infrastructure during the proposed action period. Water is currently not being applied to the constructed backwaters at Planet Ranch while additional improvements are being made. This water could be made available to maintain the existing cottonwood-willow and marsh habitat downstream of the constructed backwaters.

2024AMM6 – Collaborate with mainstem NWRs to enhance and protect existing habitat areas. Collaborate with staff at the four NWRs (Havasu, Bill Williams River, Cibola, and Imperial) to protect and enhance existing habitat. At Havasu NWR and Bill Williams NWR, the LCR MSCP could provide riparian planting material to be used in restoration efforts of previously burned habitat areas. At Imperial NWR, the LCR MSCP will work with staff to identify potential habitat improvements, such as minor grading of existing fields in combination with prescribed burns and implementation of an integrated water management plan for all marsh fields at the refuge. At Havasu NWR, the LCR MSCP is already collaborating with the refuge and the USFWS on AMM2 to ensure continued water deliveries to Topock Marsh for the benefit of Yuma Ridgway's rail, southwestern willow flycatcher, western yellow-billed cuckoo, and the northern Mexican gartersnake. The LCR MSCP will provide additional support (surveys, compliance documents, on-site biological staff) as needed to the USFWS to complete this project.

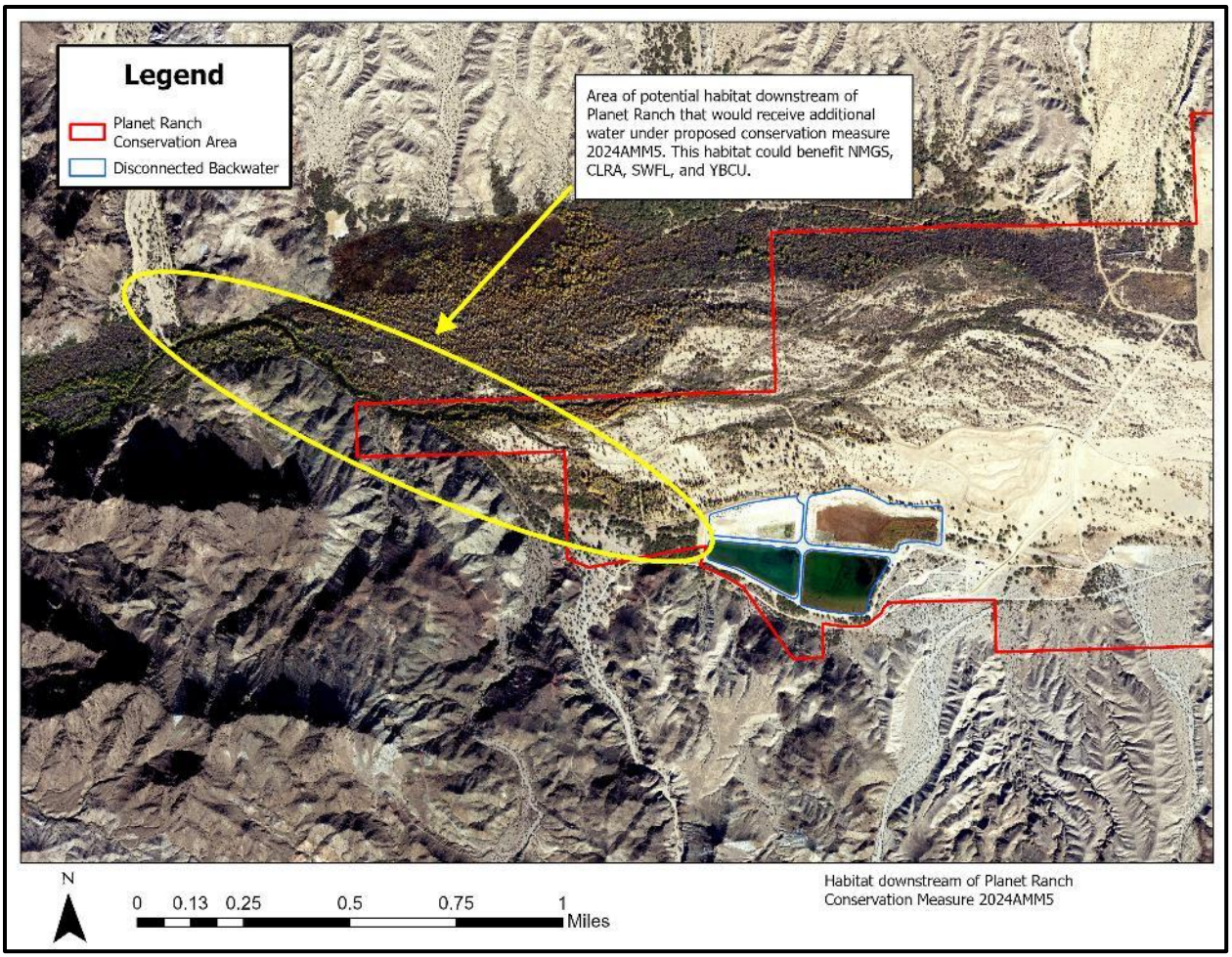


Figure 6-3. Habitat downstream of Planet Ranch, Conservation Measure 2024AMM5.

7 EFFECTS OF THE BASE AND EXPANDED ACTIONS

7.1 Summary of Effects

The potential effects of implementing the additional reduction in flow and conservation measures on threatened and endangered species are summarized in Table 7-1. Reclamation's determinations in this BA are based on applicable ESA regulations and USFWS Guidance. Since Reclamation cannot conclude that isolated take of a single individual of a species will not occur, the effects determinations have been made pursuant to this analysis (see discussion of potential take in the Endangered Species Consultation Handbook [USFWS and National Marine Fisheries Service 1998:3–12]). Furthermore, although implementing the conservation measures may result in take of covered species, the net effects of implementing the conservation measures will be to avoid, minimize, and fully mitigate effects on the seven listed species. Attachment 4 lists other threatened and endangered species in the action area that will not be affected by the increased reduction in flow.

Table 7-1. Summary of Effects Analysis

Common and Scientific Name	Federal Status	No Effect	May Affect/ Not Likely to Adversely Affect	May Affect/ Likely to Adversely Affect	May Affect/ Not Likely to Adversely Affect Critical Habitat	May Affect/ Likely to Adversely Affect Critical Habitat
Bonytail *Gila elegans*	FE			X		X
Humpback chub *Gila cypha*	FT			X		
Northern Mexican gartersnake *Thamnophis eques megalops*	FT			X		
Razorback sucker *Xyrauchen texanus*	FE			X		X
Southwestern willow flycatcher *Empidonax traillii extimus*	FE			X		
Western yellow-billed cuckoo *Coccyzus americanus occidentalis*	FT			X		
Yuma Ridgway's rail *Rallus obsoletus yumanensis*	FE			X		

FE = Endangered; FT = Threatened

The proposed action may affect and is likely to adversely affect the northern Mexican gartersnake. The proposed action may result in take of the northern Mexican gartersnake and could affect up to 84 acres (total impacts from proposed base and expanded actions) of marsh habitat, which is potential habitat for the northern Mexican gartersnake. The proposed action may have additional, temporary impacts to 149 acres (16 acres of marsh and 133 acres of cottonwood-willow) of potential habitat at Topock Marsh due to delayed completion of projects related to full implementation of AMM2, which was designed to avoid impacts of flow-related covered activities on covered species habitats at Topock Marsh (see Section 4.5.28.1 of LCR MSCP 2020a). Implementation of conservation measures, including creation of 41 acres of new marsh habitat and additional avoidance and minimization measures, will offset the effects of reduction in flow.

The proposed action may affect and is likely to adversely affect the Yuma Ridgway's rail. The proposed action may result in take of the Yuma Ridgway's rail and could affect up to 84 acres of backwaters with emergent marsh habitat (total impacts from proposed base and expanded actions), which are used by Yuma Ridgway's rail. The proposed action may have additional, temporary impacts to 16 acres of potential marsh habitat at Topock Marsh due to delayed completion of projects related to full implementation of AMM2, which was designed to avoid impacts of flow-related covered activities on covered species habitats at Topock Marsh (see Section 5.5.1.1 of LCR MSCP 2004b). Implementation of conservation measures, including creation of 41 acres of new marsh habitat and additional avoidance and minimization measures, will offset the effects of reduction in flow.

The proposed action may affect and is likely to adversely affect the southwestern willow flycatcher. Almost all existing and potential habitat for the southwestern willow flycatcher that will be affected was previously analyzed (see Section 4), incidental take was issued, and mitigation was established under the LCR MSCP (LCR MSCP 2004a, USFWS 2005a). An exception to this includes Topock Marsh, which was excluded from impacted habitat based on the implementation of AMM2. Increased reduction in flow

may temporarily affect 10.9 acres of southwestern willow flycatcher breeding sites[15] at Topock Marsh due to delayed completion of projects related to full implementation of AMM2, which was designed to avoid impacts of flow-related covered activities on covered species habitats at Topock Marsh (see Section 5.5.2.1 of LCR MSCP 2004b). Implementation of avoidance and minimization conservation measures and continued implementation of the LCR MSCP will offset the effects of reduction in flow.

The proposed action may affect and is likely to adversely affect the western yellow-billed cuckoo. Almost all cottonwood-willow existing and potential habitat for the western yellow-billed cuckoo that will be affected was previously analyzed (see Section 4), incidental take was issued, and mitigation was established under the LCR MSCP (2005). An exception to this includes Topock Marsh which was excluded from impacted habitat based on the implementation of AMM2. Increased reduction in flow may temporarily affect 133 acres of potential cottonwood-willow habitat at Topock Marsh due to delayed completion of projects related to full implementation of AMM2, which was designed to avoid impacts of flow-related covered activities on covered species habitats at Topock Marsh (see Section 5.5.14.1 of LCR MSCP 2004b). Implementation of avoidance and minimization conservation measures and continued implementation of the LCR MSCP will offset the effects of reduction in flow.

The proposed action may affect and is likely to adversely affect the humpback chub. This effect will be the consequence of reduced releases from Hoover Dam that will result in increased Lake Mead elevations. The LCR MSCP included the effects of future flow-related covered activities, including reductions in flow, on Lake Mead water surface elevations from full pool down to a water surface elevation of 950 feet. The purpose of the proposed action (reduction in flows in Reaches 2 through 5) is to increase storage (and reservoir elevations) in Lake Mead and will not result in reservoir elevations outside of previously analyzed elevations (950 feet to full pool at 1,229 feet). Because reservoir fluctuations would still occur under the proposed action within this range, the increase in flow reductions would not have an effect above the effects already analyzed in the original LCR MSCP.

The proposed action may affect and is likely to adversely affect the bonytail and its designated critical habitat. This effect will be the consequence of reduced flows in Reaches 2 through 5 that will result in reduced riverine area and area of backwaters occupied by stocked bonytail. These backwaters are both natural and human-made and may be connected or disconnected from the mainstem (e.g., CHLP; the Big Bend, Mohave Valley, Section 26, and Imperial Ponds Conservation Areas). Additionally, there is no evidence of successful reproduction or recruitment of bonytail in the mainstem lower Colorado River; however, multiple small populations persist in off-channel habitats free of nonnative fish species, including CHLP and three ponds at the IPCA. Take of bonytail may occur as a consequence of reduced habitat in backwaters occupied by this species in Reaches 3 through 5. The proposed action could result in additional impacts to 208 acres (total impacts from proposed base and expanded actions) of aquatic habitat (132 acres of backwater habitat plus 76 acres of riverine habitat) that is used by bonytail. Implementation of conservation measures, including creation of 109 acres of new, disconnected backwater habitat and additional avoidance and minimization measures, will offset the effects of reduction in flow.

The proposed action may affect and is likely to adversely affect the razorback sucker and its designated critical habitat. While the increase in flow reductions would not have an effect in Reach 1 (Lake Mead) above the effects already analyzed in the original LCR MSCP, reduced flows in Reaches 2 through 5

[15] The 2004 BA states that "the LCR MSCP will avoid the potential effects of lowering groundwater elevations on an additional 2,135 acres of habitat at Topock Marsh by maintaining water deliveries to Topock Marsh and thereby maintaining water levels and existing conditions". The 2,135 acres referred to was primarily unoccupied habitat (of the 2,135 acres of total habitat, 78 acres were occupied in 2001) and was marginal saltcedar land cover type (2,091 of 2,135 acres). Recent monitoring shows that 10.9 acres of the Topock Marsh is occupied by the southwestern willow flycatcher. Therefore, temporary impacts to southwestern willow flycatcher at Topock Marsh in the context of this consultation are limited to the currently occupied habitat.

would result in reduced habitat and area of backwaters occupied by stocked razorback suckers that are also used as larval nursery habitat. There is some reproduction in these reaches, but no recruitment has been documented. Take of razorback sucker may occur as a consequence of reduced habitat in backwaters occupied by this species in Reaches 3 through 5. The proposed action could result in additional impacts to 208 acres (total impacts from proposed base and expanded actions) of aquatic habitat (132 acres of backwater habitat plus 76 acres of riverine habitat) which is used by razorback sucker. Implementation of conservation measures, including creation of 109 acres of new, disconnected backwater habitat and additional avoidance and minimization measures, will offset the effects of reduction in flow.

8 ANALYSIS OF IMPACTS AND LEVEL OF TAKE

This section describes the methodologies used to analyze potential effects on habitats (as a surrogate for effects on species) for covered species from the increase in reduction in flow. The analysis of impacts described below follows the methods used in the 2004 LCR MSCP analysis (LCR MSCP 2004a, LCR MSCP 2004c) and in the 2022 BA (LCR MSCP 2022) to provide consistency and comparability.

The analysis uses the best available data, which consists of the following data inputs as described in Appendices J and K of LCR MSCP (2004c):

1) Backwater mapping that was prepared in 2000 using 1997 aerial imagery and associated in situ data on select backwaters (GEO/Graphics, Inc. 2000)
2) Monthly distribution of non-discretional water deliveries (Section J.4.3, Appendix J)
3) Hourly release patterns derived from historical lower Colorado River operating conditions (Section J.5, Appendix J)
4) Muskingum routing information to route hourly releases to downstream locations (Section J.6.2, Appendix J)
5) River stage information derived from 33 modeled cross-sections (Section K.2.1, Appendix K)

The above inputs are the same inputs used in the original 2004 LCR MSCP analysis and represent the best available data. A review of these datasets and corresponding assumptions was performed to determine the suitability of using these inputs for predicting the impacts of the proposed action. The review shows that the methodology still represents the worst-case scenario. Reclamation is already addressing the need for more contemporary information to be used in future consultations so that impacts of changes to operations can be more accurately predicted. Reclamation collected bathymetry during 2022 for the entire lower Colorado River mainstem from Hoover Dam to the Southerly International Boundary. These data were received in December 2022, so were unable to be incorporated into an updated hydrologic model. Development of an updated hydrologic model has begun and will be ready for use in future consultations. Updates to the remaining inputs listed above are also underway and will be ready for use in future consultations. The 2022 bathymetry is used in this BA for certain analyses and visualizations but should be used with caution for further analysis since the hydrologic modeling used in the impacts analysis uses the inputs as described above from the 2004 analysis. Reclamation has ensured that analysis in this BA derived from the use of the 2022 bathymetry, in combination with modeling results using 2004 impacts analysis inputs, is valid.

This analysis looks at the incremental change in hydrologic conditions and effects on land cover type and species' habitat from the proposal to increase the reduction in flow coverage between Hoover Dam and Imperial Dam (Reaches 2 through 5) from 1.574 mafy up to a range of 2.083 mafy to 3.0 mafy during the interim coverage period under this BA. The analysis also considers the long-term impacts of reductions in flow up to 2.083 mafy through the original term of the LCR MSCP (2055) even though coverage is only

being requested for the interim coverage period. The 2004 LCR MSCP reduction in flow in Reaches 4 and 5 (1.574 mafy) and the reduction in flow in Reaches 2 and 3 (1.574 mafy) analyzed in the 2022 BA provide the baseline for this analysis.

For the northern Mexican gartersnake, Yuma Ridgway's rail, bonytail, and razorback sucker, Reclamation uses the habitat surrogate approach of assuming that a reduction in habitat as a function of reduction in flow equates to potential take of the species. Hence, a reduction in surface area of backwater habitats or emergent marsh equates to possible "take" of these species. For the bonytail and razorback sucker, this approach is also applied to impacted riverine habitat.

For the western yellow-billed cuckoo and southwestern willow flycatcher, impacts to habitat using the habitat surrogate approach was analyzed under the 2004 LCR MSCP analysis. Table 3-11 in the 2004 HCP (LCR MSCP 2004a) shows that 1,534 acres of western yellow-billed cuckoo habitat would be impacted by covered activities in Reaches 3 through 5. Similarly, 1,853 acres of southwestern willow flycatcher habitat would be impacted by covered activities. These acreages represent all the habitat that existed at the time of the 2004 analysis with some exclusions as detailed in the 2004 HCP (LCR MSCP 2004a); incidental take was issued for impacts to this habitat, and mitigation was established under the LCR MSCP (LCR MSCP 2004a, USFWS 2005a). It is assumed that no new habitat has been naturally established in additional locations of the action area for these two species (none has been observed during system-wide monitoring or via remote sensing). The only cottonwood-willow habitat that is analyzed in this BA is the existing habitat at Topock Marsh.

For the humpback chub, impacts to occupied habitat in Reach 1 (Lake Mead), as a result of Hoover Dam operations, are expected to be minor. Humpback chub are present within the action area from Separation Canyon downstream to the Colorado River interface with Lake Mead. At lower reservoir elevations (approximately 1,090 feet and below), this 55-mile stretch of river is segmented into two reaches by the Pearce Ferry Rapid. The Pearce Ferry Rapid is a barrier to upstream movement of fishes (from Lake Mead to the Grand Canyon) at these elevations. The proposed action has a low probability of resulting in lake elevations above 1,090 feet (see Figure 2-2), so habitat above the Pearce Ferry Rapid will not likely be affected by this action. Relatively few humpback chub (< 30) have been captured or contacted downstream of the rapid each year since 2017 (Kegerries et al. 2017, 2018, 2019, 2021; Rogers et al. 2021, 2022), and the presence of this approximately 15-mile section of transitory river between the rapid and Lake Mead is not currently significant to the humpback chub as large populations and habitat upstream of the rapid would not likely be affected by the proposed action. Both the available transitory habitat and the presence of relatively few humpback chub currently downstream of the Pearce Ferry Rapid were predicted in 2004, and the potential effects of the proposed action were fully mitigated for through implementation of the conservation measure identified for this species in the 2004 HCP (LCR MSCP 2004a). Over the term of the LCR MSCP, reservoir operations are expected to result in some low level of take.

8.1 Assessment of the Proposed Action on Hydrologic Conditions in Reach 1

8.1.1 Base Action

The proposed base action would not affect Lake Mead beyond the effects already analyzed in the original LCR MSCP. The original analysis analyzed the effects of future flow-related covered activities, including reductions in flow from Hoover Dam, on Lake Mead water surface elevations from full pool down to a water surface elevation of 950 feet. The purpose of the proposed base action (reduction in flows in Reaches 2 through 5) is to increase storage (and reservoir elevations) in Lake Mead and will not result in

reservoir elevations outside of previously analyzed elevations (950 feet to full pool at 1,229 feet). Because reservoir fluctuations would still occur under the proposed action within this range, the increase in flow reductions would not have an effect above the effects already analyzed in the original LCR MSCP. Hydrologic modeling was conducted for Lake Mead reservoir elevations as part of the NEPA process for the SEIS (see Figure 2-2). The 10th percentile minimum Lake Mead reservoir elevation from this modeling was just above 1,025 feet for the proposed SEIS action during the interim SEIS period ending in December 2026. The 90th percentile maximum Lake Mead reservoir elevation was approximately 1,095 feet for this same period.

8.1.2 Expanded Action

The assessment of the proposed action on hydrologic conditions in Reach 1 is expected to be similar between the proposed base action and the proposed expanded action. The additional 917,000 af of reductions under the proposed expanded action is not expected to result in any additional impacts on the hydrologic conditions in Reach 1 that were not previously analyzed in the original LCR MSCP. The additional reductions in flow would probably occur if hydrologic conditions warranted them (lower inflows to Lake Mead resulting in lower Lake Mead reservoir elevations). Since additional reductions in flow might be needed due to lower reservoir elevations, the resulting reservoir elevations from more water left in Lake Mead would likely be within the range of elevations presented in Figure 2-2.

8.2 Assessment of the Proposed Action on Hydrologic Conditions in Reach 2

8.2.1 Base Action

An increase in the reduction of flow from 1.574 mafy to 2.083 mafy from Hoover Dam to Davis Dam (Reach 2) is not expected to change the reservoir volume or elevation due to the proposed action because of ongoing management as part of the 2004 LCR MSCP baseline. Since the hydrologic impacts of the proposed action in Reach 2 are not expected to affect riverine or reservoir conditions, they were not modeled. This conclusion is consistent with the 2004 LCR MSCP analysis and with the 2022 BA.

Lake Mohave is operated as a re-regulating reservoir to balance water releases from Hoover Dam and aid in the delivery of water supplies to downstream users. It also facilitates management of reservoir levels in Lake Havasu to limit large fluctuations in water levels that could impact the Mark Wilmer Pumping Plant, the W.P. Whitsett Intake Pumping Plant, and Lake Havasu City. Historically, this management led to frequent fluctuations within Lake Mohave. To avoid the potential impacts of water level fluctuations to razorback sucker and bonytail, especially during the critical spawning season, Reclamation exchanged memoranda (1994 Memorandum) with the USFWS in 1994 and committed to managing Lake Mohave water surface elevation at 640 feet mean sea level and limiting fluctuations to less than 2 feet in any 10-day period between March 15 and September 1 (Reclamation 1994). These management criteria have been implemented since 1994 and are part of the baseline operating conditions.

Since Lake Mohave is a re-regulating reservoir, its primary purpose is not water storage. While water releases from Hoover Dam into Lake Mohave and water releases from Davis Dam out of Lake Mohave fluctuate monthly and annually due to water delivery and power production, water volumes and elevations do not change significantly during most water years. Over the last 5 years, the difference in annual releases from Davis Dam compared to Hoover Dam ranged from 95% to 101% of the Hoover Dam releases. Total water releases from Hoover Dam have ranged from 9,144,952 afy to 8,514,582 afy over the last 5 years. Releases from Davis Dam have ranged from 8,950,100 afy to 8,124,499 afy over the same period (Reclamation 2017, 2018a, 2019, 2020a, 2021b). Water reductions and changes in point of

diversion covered under the 2004 LCR MSCP have not changed this pattern. In 2019, water reductions covered under the LCR MSCP were the highest since the beginning of the program. The flow reductions in Reach 2 totaled 818,255 afy (Reclamation 2020b). At the end of 2019, the water volume in Lake Mohave was 1,000 af less than the beginning of 2019. The total volume in Lake Mohave at the beginning of 2019 was 1,639,000 af and 8,514,582 af was released from Hoover Dam into Lake Mohave that year, yet the change in lake volume was less than 0.001% of the total volume. The largest change in lake volume during the most recent 5-year period of published data is 3% occurring in 2020 when beginning Lake Mohave storage was 1,638,000 af and ending storage was 1,586,000 af. Figure 8-1 shows the Lake Mohave reservoir elevation for the most recent 5-year period of published data. The figure shows that except for the fall drawdown periods, the reservoir is maintained at a relatively constant elevation.
The historical purpose of the fall drawdown was to provide flood control storage space that resulted from large hurricane-type storms coming upriver from Mexico (see Section J.4.3.2, Appendix J of LCR MSCP 2004c). Reclamation began taking advantage of the fall drawdown period to aid in harvesting razorback suckers from lakeside rearing ponds. It is possible that these fall drawdowns will be discontinued if not needed for operational purposes. If that occurs, harvesting of razorback suckers in lakeside rearing ponds would continue, but the procedure would be modified to accommodate for the higher water levels.
The proposed action would not affect Reclamation's ability to maintain relatively static reservoir levels in Lake Mohave. Any habitat that may be affected by these small changes in storage and reservoir elevations is unmeasurable and management activities will limit impacts even with the proposed reductions in flow. The proposed base action includes reductions of up to 2.083 maf. Despite these large reductions, there would still be approximately 7 maf released from Hoover Dam into Lake Mohave, allowing for sufficient water to continue current operations.

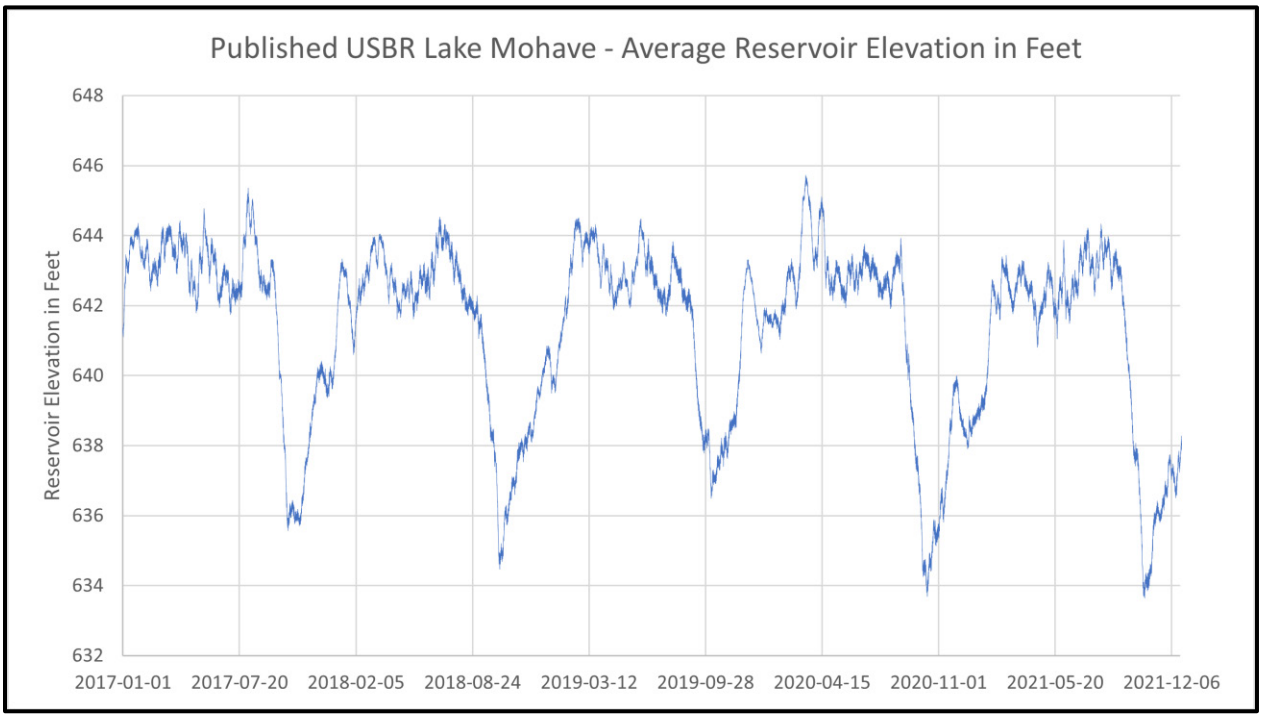


Figure 8-1. Lake Mohave reservoir elevations for the 5-year period from January 1, 2017 to December 31, 2021.

USBR = Bureau of Reclamation

Lake Mohave is situated behind Davis Dam and is bounded for most of its 67-mile length by the steep wall of Pyramid, El Dorado, and Black Canyons. The lake is relatively narrow, not more than 4 miles across at its widest point. Marsh land cover type within Lake Mohave is limited to small patches of less

than 1 acre, usually associated with small coves exposed to lake fluctuations, wind, and wave action. These areas are less than the minimum patch size and do not provide the necessary habitat requirements for Yuma Ridgway's rails. Infrequent, small patches of cottonwood-willow land cover type exist in protected coves; however, current and past Lake Mohave operations have limited and will continue to limit regeneration of riparian plant species. No naturally occurring backwater habitat exists in Reach 2; all existing backwaters were created and managed by Reclamation prior to the LCR MSCP to grow out native fish for stocking into Lake Mohave and to conduct research. These backwaters are disconnected from the lake; native fish are stocked into the backwaters in the spring and recaptured in the fall of the same year for release. During the fall drawdown, Reclamation takes advantage of lower water levels to facilitate this process. These backwaters do not meet the criteria for created backwater habitat under the LCR MSCP. They are not impacted by the proposed action.

In addition to Lake Mohave reservoir elevations not being impacted by the proposed action, water temperature is also not expected to be impacted. From January 1, 2010, to October 11, 2022, Lake Mead reservoir elevations ranged from a maximum of 1,135 feet to a minimum of 1,041 feet. During that time, Hoover Dam tailrace temperatures ranged from a maximum of 68.5°F to a minimum of 49°F (Figure 8-2). These data demonstrate that the tailrace temperatures in Lake Mohave are controlled by a combination of seasonal stratification patterns in Lake Mead, the time of year, the elevation of Lake Mead, and how Hoover Dam withdrawals are split between upper and lower intakes. The slope of the tailrace temperature trendline is extremely small and increases in temperature have been limited to later in the stratification cycle in Lake Mead when warmer surface waters encounter the intakes. Additionally, the intent of the proposed action is to increase reservoir elevations in Lake Mead which would likely result in preventing any additional increases to Hoover Dam tailrace temperatures as long as water is drawn from the lower layers of the lake.

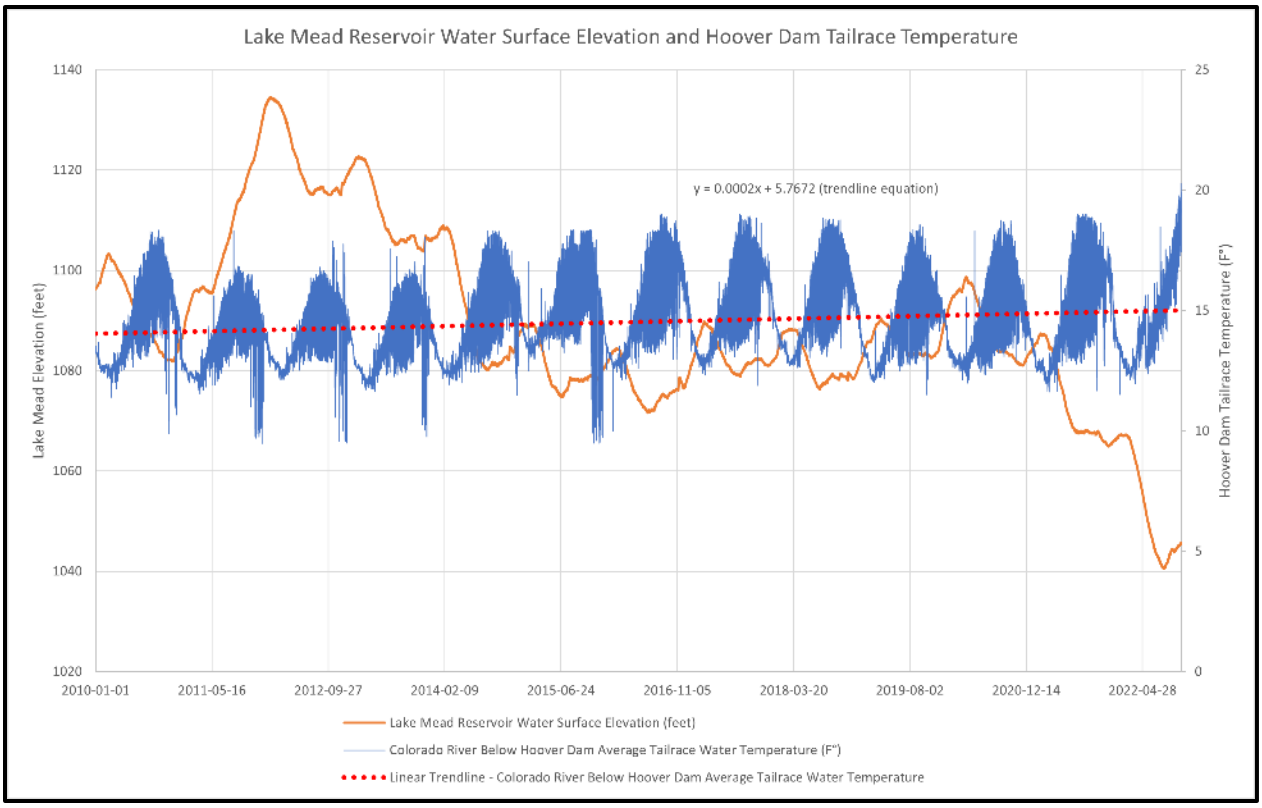


Figure 8-2. Lake Mead reservoir elevations and Hoover Dam tailrace temperatures for the period from January 1, 2010, to October 11, 2022.

°F = degrees Fahrenheit

As part of the SEIS analysis, Hoover Dam tailrace temperatures were modeled using the Lake Mead W2 model. The model was run for three traces under the SEIS No Action and SEIS Proposed Action alternatives resulting in six unique scenarios using four different hydrologic traces (Figure 8-3). For each trace modeled, the inputs used were simulated results from the Lake Powell W2 model for the corresponding trace (Section 3.8 of the SEIS, being published in fall 2023, will provide more information).

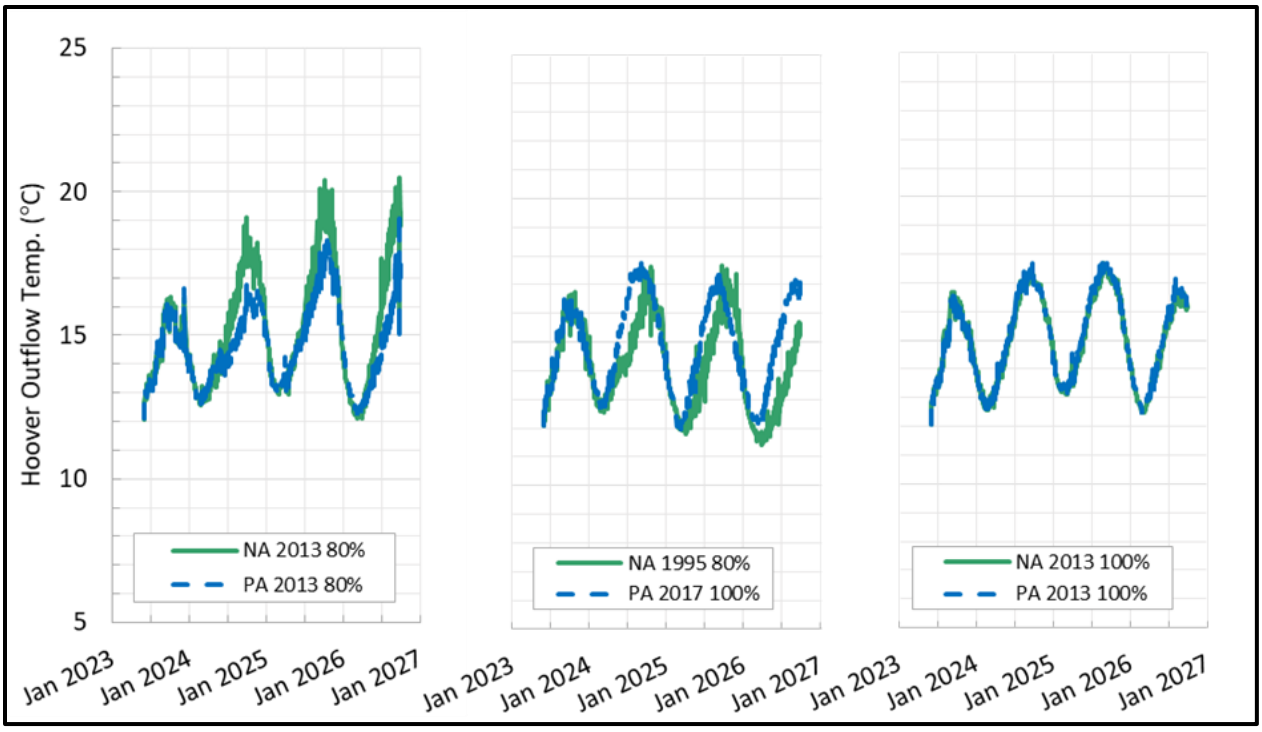


Figure 8-3. Predicted temperature of Hoover Dam outflow for selected traces for the SEIS No Action and Proposed Action scenarios from the Lake Mead W2 model.

°C = degrees Celsius; Jan = January; NA = no action; PA = proposed action; Temp. = temperature

The results from the Lake Mead W2 model (Hydros 2019, 2022) show that Hoover Dam tailrace temperatures vary between the SEIS no action and SEIS proposed action scenarios, but the variability is influenced more by hydrologic trace used rather than flow reduction scenario (see Figure 8-3). The results from the model show that Hoover Dam tailrace temperatures are predicted to remain cooler when Lake Mead elevations are maintained or kept higher (rightmost panel in Figure 8-3 representing the 2013 100% trace and the middle panel in Figure 8-3 containing the 1995 80% trace and the 2017 100% trace). Since the proposed action is intended to increase reservoir elevations in Lake Mead, the model results confirm there will likely be no additional increases to Hoover Dam tailrace temperatures compared to what has been observed over the past 12 years (see Figure 8-2).

It is unknown how reduced flows or changes in temperature will affect nonnative predatory fish populations. Currently, predation by nonnative fish and piscivorous avian species results in almost 100% mortality of native larvae in the mainstem; therefore, Reclamation expects little change in the impacts on native fish populations. Essentially 100% of native fish larvae in the mainstem portion of the action area do not advance to the next life stage (juvenile); therefore, even though changes are not expected in the nonnative predatory fish population, the impacts on the existing native stock are not expected to be significant. As mentioned above, the intent of the proposed action is to increase reservoir elevations in Lake Mead, so no change is expected to the downstream nonnative predatory fish populations as a result of the proposed action due to increased entrainment.

Minimum instantaneous releases from Hoover Dam are not expected to change from the baseline scenario as analyzed in the original LCR MSCP (see Section J.5.1, Appendix J of LCR MSCP 2004c).
The historical instantaneous minimum release is approximately 500 cubic feet per second (cfs) and would be associated with downstream flooding, construction, search and rescue, or other emergency conditions. Minimum mean daily release under the baseline condition is 800 cfs and would be associated with

seasonal fluctuations in downstream demands. These minimums are not expected to change under the proposed base action and would not have any impacts on the approximately 12 miles of riverine habitat immediately downstream of Hoover Dam.

An increase in the reduction of flow from 1,574,000 afy to 2,083,000 afy in Reach 2 would not result in a change in management of Lake Mohave; therefore, the reservoir volume and elevation are not expected to change from existing conditions due to the proposed action. Additional impacts to razorback suckers or bonytail would not differ from impacts analyzed in the 2004 LCR MSCP BA. The proposed action would not limit Reclamation's ability to comply with the 1994 Memorandum, which mitigates potential impacts to spawning native fish (Reclamation 1994).

8.2.2 Expanded Action

The assessment of the proposed action on hydrologic conditions in Reach 2 is expected to be similar between the proposed base action and the proposed expanded action. The additional 917,000 af of reductions under the proposed expanded action is not expected to result in any additional impacts on the hydrologic conditions in Reach 2 due to the operation of Lake Mohave as a re-regulating reservoir.

8.3 Assessment of the Proposed Action on Hydrologic Conditions in Reaches 3 through 5

8.3.1 Base Action

As previously described, the proposed base action is an annual reduction in flow of 2.083 maf. This section describes the process for evaluating the hydrologic conditions of the proposed base action and the corresponding results for Reaches 3 through 5.

River flows are affected by the operation of dams for hydropower production and delivery of water to downstream water contract holders. Flows can vary seasonally, daily, and hourly. The 2004 analysis determined that flow reductions would not have a measurable effect on the distribution of daily water releases for hydropower production but would affect the magnitude and/or duration of the high and low hourly releases (see Appendix K.1 in LCR MSCP 2004c). Under all scenarios (baseline, previously analyzed reduction scenarios used in previous consultations, and the proposed action), the assumption is that daily release volumes do not vary significantly for a day in any given month. This assumption is still valid. What does vary and what is important in the context of the impact analysis is how the flows vary during a typical 24-hour period in a given month. The low hourly releases for a typical day result in reductions of flow and river stage downstream (Figure 8-6). Conversely, during this same 24-hour period, hourly releases will reach a maximum and will result in increases in flow and river stage downstream. These minimum stage values are not sustained, and the duration will vary depending on the overall daily release volume and hydropower demand. The reduced river stages presented in this BA are these minimum downstream values resulting from the minimum hourly flows. Even though these minimum river stage values are not sustained, they are used to determine the worst-case scenario of acres of impacted habitat. In the 2004 analysis, the impacts to acres of habitat were considered to be permanent and were mitigated accordingly. The same assumption is made for the proposed base action. Flow reductions will not have an impact on reservoir elevations in Lake Havasu as the frequency and rate of fluctuations will be the same as baseline conditions.

Modeling data were developed for the 2004 LCR MSCP analysis for flow reductions in three different months: April, August, and December. August was evaluated because backwaters provide cover for juvenile fish during the summer, while December represents the lowest water elevation throughout the

year. April was selected because river flows are at their highest; therefore, backwaters, which are important nursery areas for larval fish, are at their highest water surface elevation and acreage. April also represents the time of new growth and dormancy break for cattails and other marsh vegetation. April falls within razorback and bonytail spawning season, and within the Yuma Ridgway's rail breeding season (see Appendix K.2.1 in LCR MSCP 2004c). The largest reductions in river stage occur in April and, since the species life stages are more susceptible to changes in river stage during the spawning and breeding seasons, the greatest potential impacts to razorback sucker, bonytail and Yuma Ridgway's rail would occur at this time. The 2004 LCR MSCP assumed a "worst case scenario," so impacts were based on the April modeling projections. This approach was continued for the 2022 BA and for this analysis to provide an estimate of the potential impacts.

To evaluate the effects of reduction in flow downstream of Davis and Parker Dams, rating curves (i.e., stage-discharge relationships) were developed from flow and water surface elevations during the 2004 analysis (see Appendix J, Attachment D in LCR MSCP 2004c). These rating curves were then used to calculate the water surface elevations at various cross-section locations within Reaches 3 through 5 for the baseline scenario, the 1.574 mafy reduction scenario, and the 2.083 mafy reduction scenario. The change in river stage was calculated from these results and used to estimate acres of affected backwater, riverine, and marsh habitat.

All backwaters and associated emergent vegetation components (i.e., marsh) that were mapped in 2000 are considered to be impacted under the proposed action. See Figure 8-4 for locations of the backwaters used in this analysis. The same applies to the river in Reaches 3 through 5. This is the same assumption used in the original 2004 LCR MSCP analysis. Projected hourly minimum flows are used to define changes to water surface elevations and the resultant effect on riverine, backwater, and marsh water surface area. A bank slope of 30 degrees was used to determine surface water area changes resulting from water elevation changes; this results in the fringe around each backwater or marsh being considered impacted (see Section K.2, Appendix K of LCR MSCP [2004a] for more details). Figure 8-5 provides an example analysis for a representative backwater. The process is the same for all backwaters and marshes. The impacted fringe for each individual backwater is then summed to generate the estimate of impacted acres. A similar method is used for the mainstem river area to generate the estimate of impacted riverine acres.

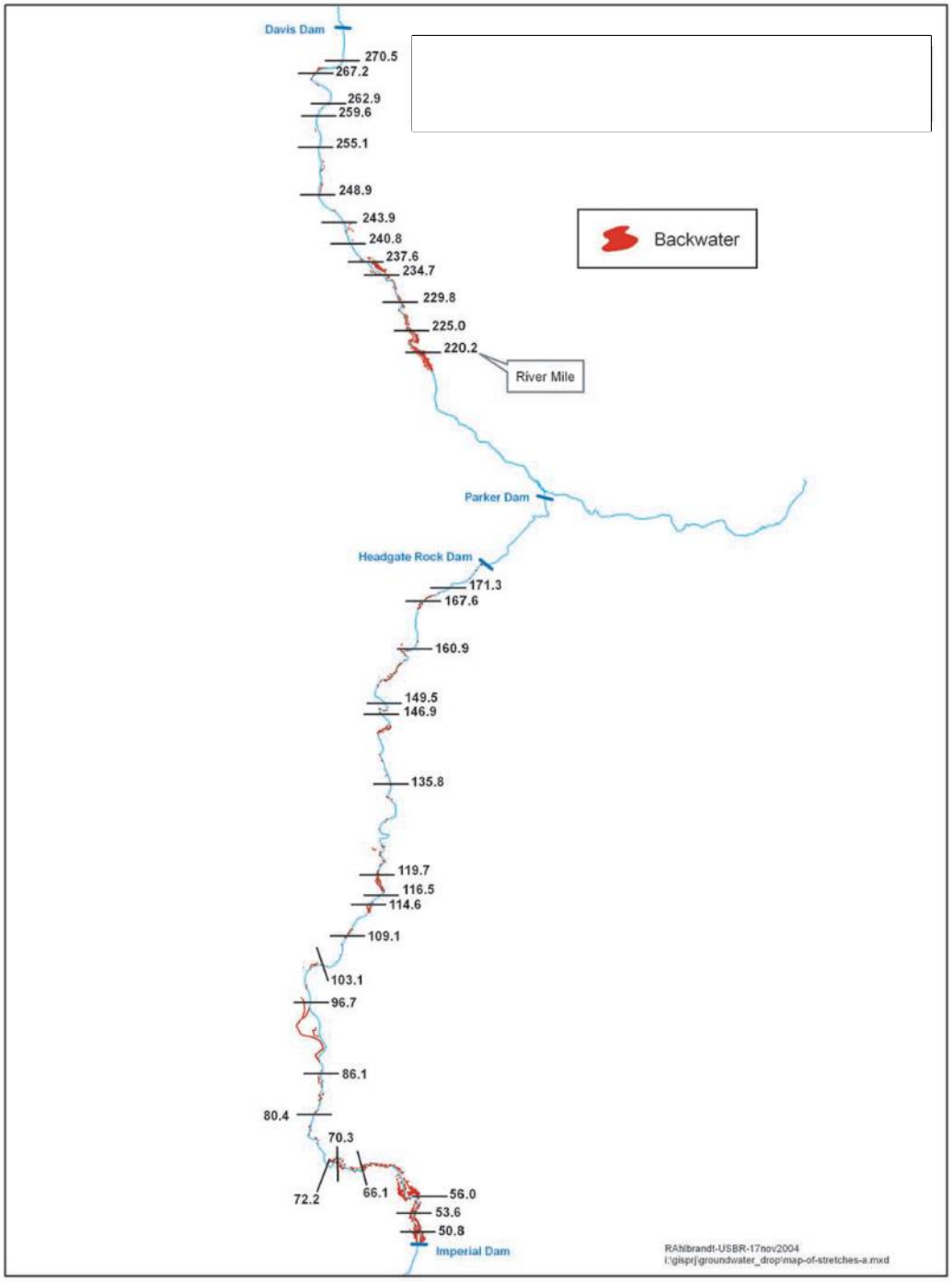


Figure 8-4. River sections and backwaters used in backwater reduction analysis (LCR MSCP 2004c).

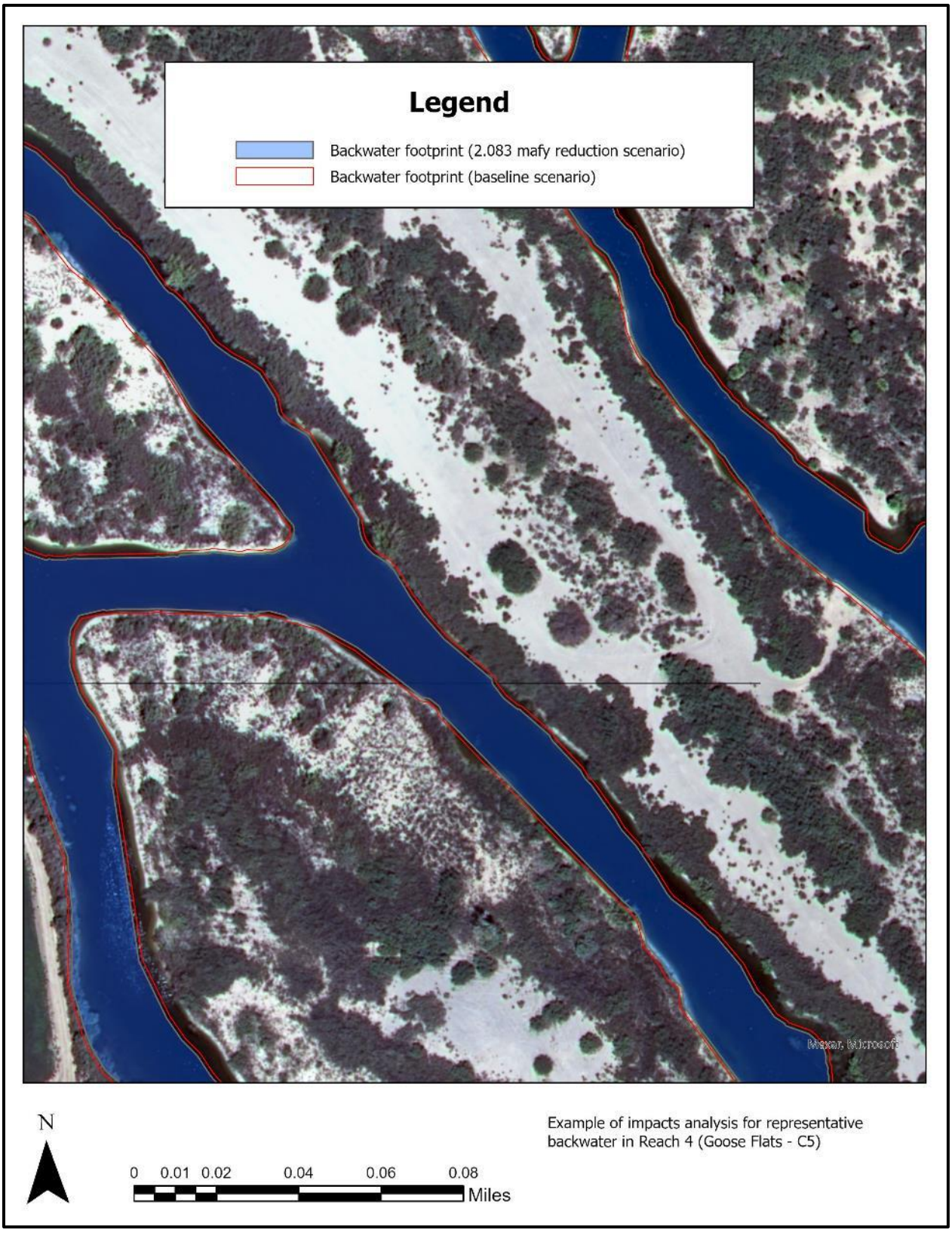


Figure 8-5. Example of impacts analysis for representative backwater in Reach 4 (Goose Flats – C5 backwater).

Table 8-1 shows the following modeling results for the 33 modeled river cross-sections:

- The table provides the minimum predicted stage for April for both the baseline scenario (i.e., no reductions in flow) (Column A) and the 2.083 mafy reduction scenario (Column B).
- The predicted reduction in stage for the existing coverage in Reaches 3 through 5 (1.574 mafy reduction in flow provided by the 2005 BO [USFWS 2005a], 2004 HCP [LCR MSCP 2004a] and 2022 BO [USFWS 2022]), which ranged from a minimum of 0.13 feet to a maximum of 3.08 feet, appears in Column C.
- The incremental predicted reduction in stage (1.574 mafy to 2.083 mafy) and the total predicted reduction in stage (0 mafy to 2.083 mafy) appear in Columns D and E, respectively. The incremental predicted reduction in stage ranges from a minimum of 0.03 feet to a maximum of 0.81 feet. The total predicted reduction in stage ranges from a minimum of 0.17 feet to a maximum of 3.13 feet.
- The table then provides information on minimum river bottom elevation (Column F), average river bottom elevation (Column H), and the predicted depth of water for these two values under a 2.083 mafy reduction (Columns G and I).
    - The depth above the minimum river bottom elevation ranges from a minimum of 4.87 feet to a maximum of 33.20 feet.
    - The depth above the average river bottom elevation ranges from a minimum of 2.35 feet to a maximum of 17.27 feet.
    - The minimum depth above the average river bottom elevation occurs at river mile 109.1 where a large sandbar occurs in the middle of the river and skews the average river bottom elevation value. A similar situation exists at river mile 167.6 where a sandbar also skews the average river bottom elevation value.
    - At river mile 109.1, there is a deep channel on one side of the sandbar that is predicted to maintain approximately 10 feet of depth above the river bottom. Similarly, at river mile 167.6, the deep channel is predicted to maintain approximately 5 feet of depth above the river bottom. Without including the cross sections at river miles 109.1 and 167.6, the depth above the average river bottom elevation would be at a minimum of 3.56 feet instead of 2.35 feet. So, even during times of predicted minimum flow and stage in April, it is predicted that at least 4.86 feet of water will be above the minimum river bottom elevation as modeled in the 33 cross sections.

Table 8-1. Changes in River Stage in April from Reductions in River Flow for an Annual Reduction in Flow of 2.083 maf

		A	B	C	D	E	F	G	H	I
Reach	**River Mile**	**Minimum Predicted Stage (feet): 2004 Baseline Scenario**	**Minimum Predicted Stage (feet): 2.083 mafy Reduction Scenario**	**Reduction in Stage (feet): 0 to 1.574 mafy**	**Incremental Reduction in Stage (feet): 1.574 to 2.083 mafy**	**Reduction in Stage (feet): 0 to 2.083 mafy**	**Minimum Elevation (feet): River Bottom**	**Depth of Water (feet): Minimum River Bottom– 2.083 mafy Reduction Scenario**	**Average Elevation (feet): River Bottom**	**Depth of Water (feet): Average River Bottom– 2.083 mafy Reduction Scenario**
3	270.5	496.59	494.42	-2.13	-0.04	-2.17	487.81	6.61	489.61	4.81
3	267.2	489.48	487.08	-2.36	-0.04	-2.40	482.21	4.87	483.46	3.62
3	262.9	477.13	474.00	-3.08	-0.05	-3.13	461.93	12.07	470.31	3.70
3	259.6	473.62	470.70	-2.86	-0.05	-2.91	459.79	10.91	464.02	6.68
3	255.1	468.53	465.41	-3.07	-0.05	-3.12	452.84	12.57	457.08	8.33
3	248.9	464.08	461.39	-2.24	-0.44	-2.68	450.75	10.64	453.65	7.74
3	243.9	458.54	455.66	-2.41	-0.48	-2.89	439.86	15.80	442.78	12.88
3	240.8	456.76	454.05	-2.26	-0.45	-2.71	442.13	11.92	444.18	9.87
3	237.6	454.02	451.59	-2.03	-0.40	-2.43	441.49	10.10	443.49	8.10
3	234.7	452.65	450.51	-1.78	-0.36	-2.14	441.64	8.87	444.64	5.87
3	229.8	450.21	448.32	-1.59	-0.29	-1.88	435.09	13.23	440.21	8.11
3	225	448.91	447.52	-1.18	-0.21	-1.39	429.57	17.95	436.08	11.44
3	220.2	447.61	446.79	-0.70	-0.12	-0.82	413.59	33.20	429.52	17.27
4	171.3	335.05	332.32	-2.46	-0.27	-2.73	322.46	9.86	326.38	5.94
4	167.6	328.67	325.72	-2.65	-0.30	-2.95	318.82	6.90	323.17	2.55
4	160.9	317.09	314.21	-2.58	-0.30	-2.88	307.31	6.90	310.46	3.75
4	149.5	299.89	296.97	-2.60	-0.32	-2.92	289.24	7.73	291.84	5.13
4	146.9	296.24	293.98	-2.01	-0.25	-2.26	284.29	9.69	289.62	4.36
4	135.8	283.97	283.63	-0.31	-0.03	-0.34	274.27	9.36	275.57	8.06
4	119.7	249.29	247.15	-1.54	-0.60	-2.14	240.25	6.90	242.28	4.87
4	116.5	243.28	240.45	-2.03	-0.81	-2.84	232.33	8.12	235.58	4.87
4	114.6	240.75	238.12	-1.87	-0.75	-2.62	226.30	11.82	233.32	4.80

		A	B	C	D	E	F	G	H	I
Reach	**River Mile**	**Minimum Predicted Stage (feet): 2004 Baseline Scenario**	**Minimum Predicted Stage (feet): 2.083 mafy Reduction Scenario**	**Reduction in Stage (feet): 0 to 1.574 mafy**	**Incremental Reduction in Stage (feet): 1.574 to 2.083 mafy**	**Reduction in Stage (feet): 0 to 2.083 mafy**	**Minimum Elevation (feet): River Bottom**	**Depth of Water (feet): Minimum River Bottom– 2.083 mafy Reduction Scenario**	**Average Elevation (feet): River Bottom**	**Depth of Water (feet): Average River Bottom– 2.083 mafy Reduction Scenario**
4	109.1	232.23	229.59	-1.90	-0.75	-2.65	217.42	12.17	227.24	2.35
4	103.1	225.61	223.33	-1.65	-0.63	-2.28	213.89	9.44	218.49	4.84
4	96.7	217.27	214.61	-1.92	-0.74	-2.66	201.95	12.66	210.41	4.20
5	86.1	208.09	206.06	-1.43	-0.60	-2.03	192.82	13.24	202.50	3.56
5	80.4	202.97	201.24	-1.23	-0.50	-1.73	189.75	11.49	194.08	7.16
5	72.2	195.17	193.32	-1.32	-0.53	-1.85	183.10	10.22	189.15	4.17
5	70.3	194.13	192.26	-1.34	-0.53	-1.87	182.58	9.68	187.66	4.60
5	66.1	190.14	188.23	-1.39	-0.53	-1.92	179.00	9.23	183.72	4.51
5	56	184.88	183.40	-1.08	-0.40	-1.48	171.50	11.90	176.80	6.60
5	53.6	181.62	180.66	-0.73	-0.23	-0.96	171.51	9.15	172.81	7.85
5	50.8	179.81	179.65	-0.13	-0.04	-0.17	169.58	10.07	171.86	7.79

Figure 8-6 and Figure 8-7 show the flow routing from Davis Dam for both the baseline and the proposed base action scenario of the 2.083 mafy reduction in flow. Figure 8-8 and Figure 8-9 show the flow routing from Parker Dam for both the baseline and the proposed base action scenario of the 2.083 mafy reduction in flow.

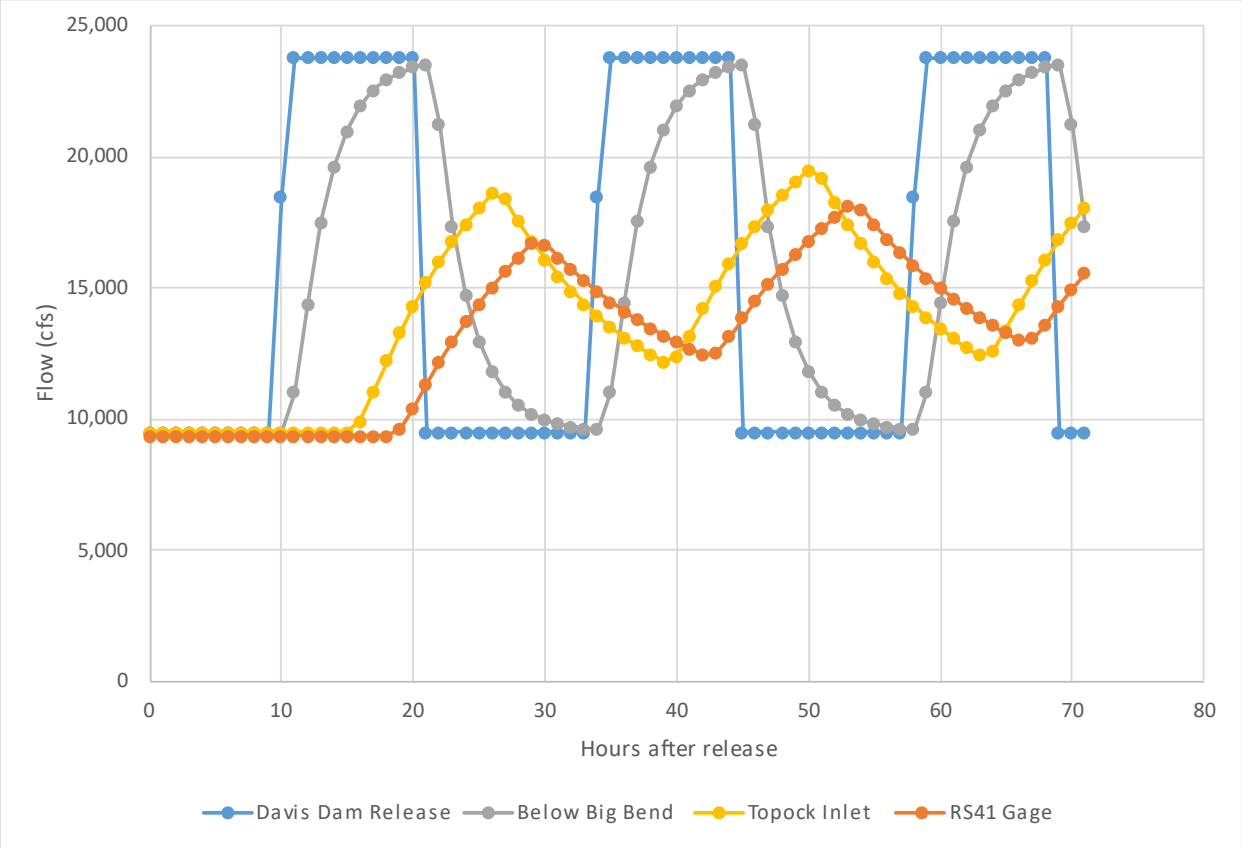


Figure 8-6. April flow routing for releases from Davis Dam, 2004 baseline scenario.

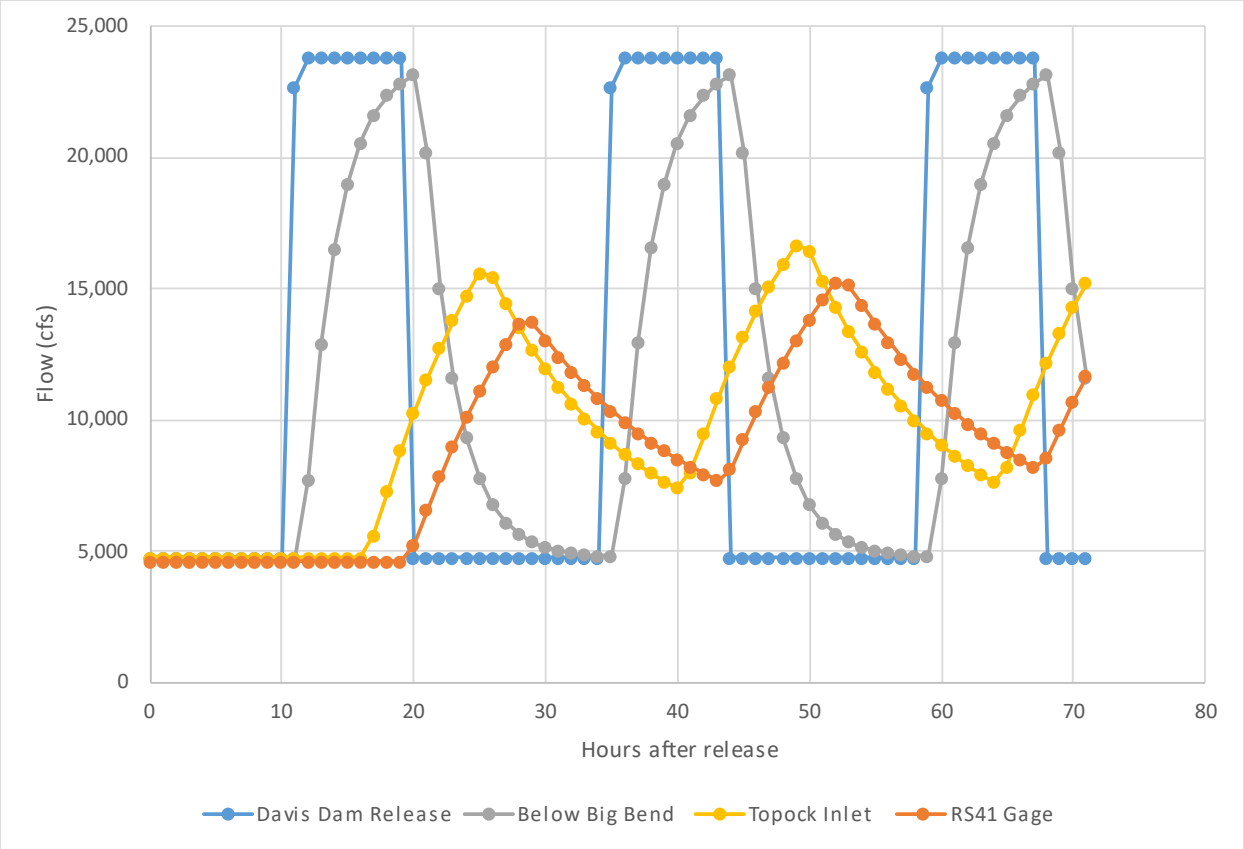


Figure 8-7. April flow routing for releases from Davis Dam, 2.083 mafy reduction scenario.

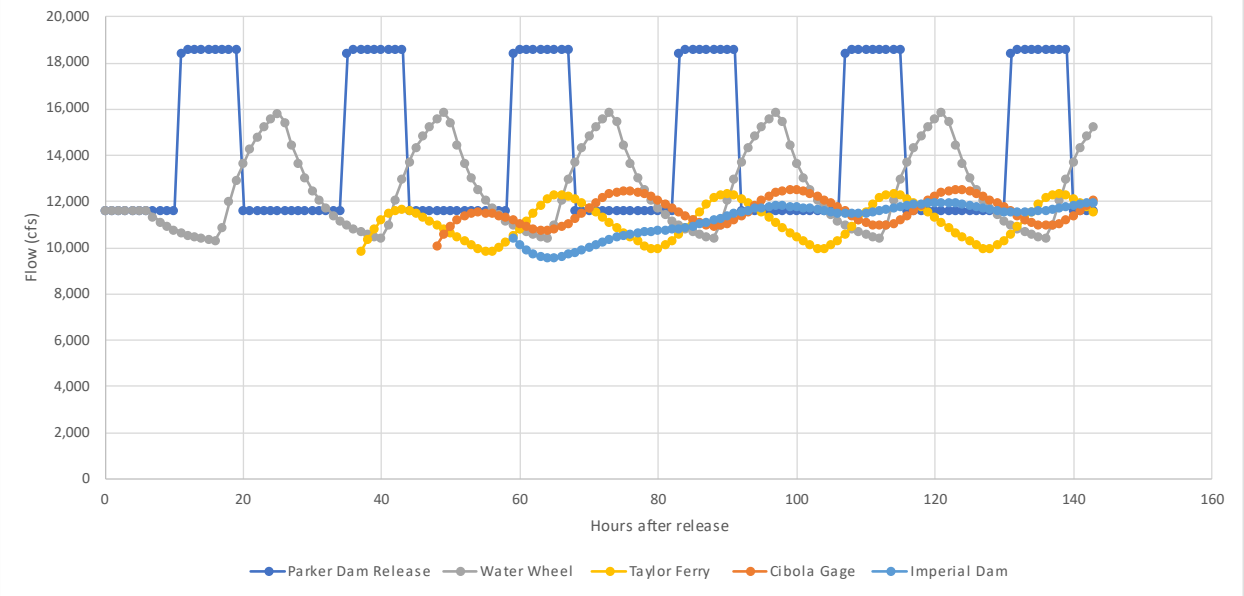


Figure 8-8. April flow routing for releases from Parker Dam, 2004 baseline scenario.

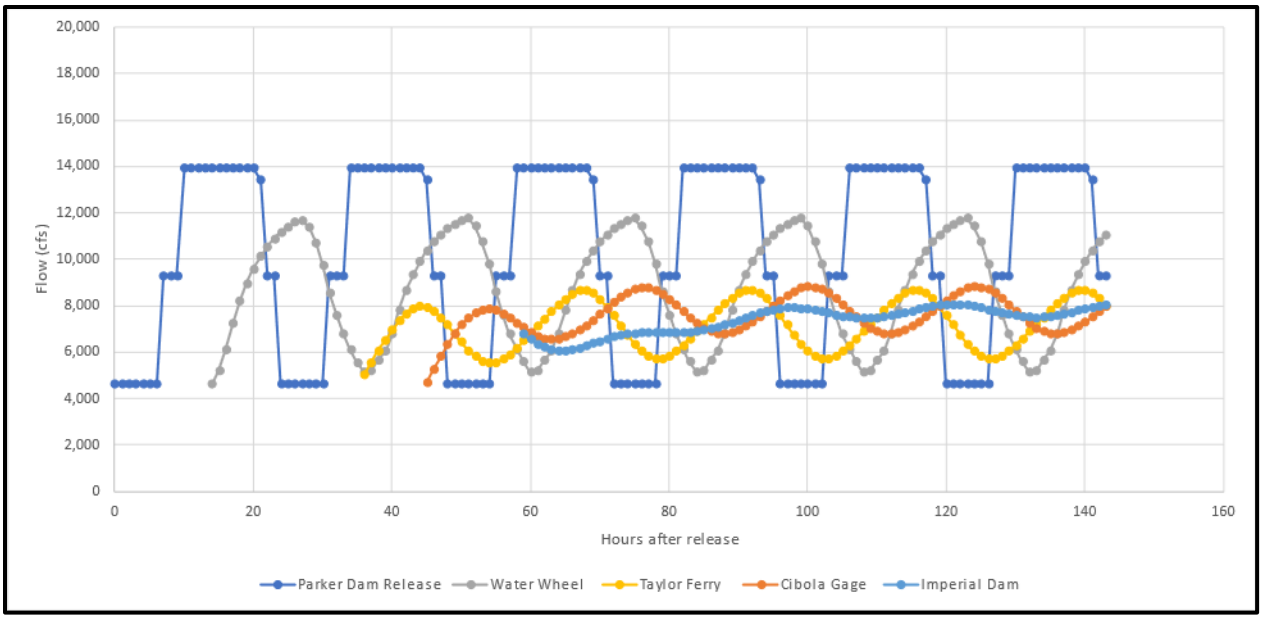


Figure 8-9. April flow routing for releases from Parker Dam, 2.083 mafy reduction scenario.

Table 8-2 and Table 8-3 show the predicted impacts to riverine, marsh, and backwater habitats as a result of the reduced river stage due to the proposed base action. The methodology for predicting these impacts is described in Section K.1, Appendix K of LCR MSCP (2004c).

Table 8-2. Predicted Reduction in River Area Acres for April

Reach	Current River Area (acres, 2004 baseline)	Incremental Reduction in River Area (acres) 1.574 to 2.083 mafy	Total Reduction in River Area (acres) 0 to 2.083 mafy
3	3,585	6	65
4 and 5	10,303	40	189
Total	**13,888**	**46**	**254**

Table 8-3. Predicted Reduction in Backwater Area Acres for April

Reach	Current Total Backwater Area (acres, 2004 baseline)	Incremental Reduction in Backwater Emergent Area (acres) 1.574 to 2.083 mafy	Total Reduction in Backwater Emergent Area (acres) 0 to 2.083 mafy	Incremental Reduction in Backwater Open-Water Area (acres) 1.574 to 2.083 mafy	Total Reduction in Backwater Open-Water Area (acres) 0 to 2.083 mafy
3	3,289	6	37	2	12
4 and 5	7,234	35	143	22	90
Total	**10,523**	**41**	**180**	**24**	**102**

8.3.2 Expanded Action

As previously described, the proposed expanded action is an annual reduction in flow of 3.0 maf. The previous section described the process for evaluating the hydrologic conditions of the proposed base

action. The process for evaluating the proposed expanded action is identical. Therefore, this section only presents the corresponding results associated with the proposed expanded action. Since the proposed expanded action has a low probability of occurring and an even lower probability of occurring for multiple years during the interim coverage period, the impacts presented in this section are considered to be temporary and will likely not result in permanent impacts to habitat if the proposed expanded action is needed.

Table 8-4 shows the following modeling results for the 33 modeled river cross-sections:

- The table provides the minimum predicted stage for April for both the baseline scenario (i.e., no reductions in flow) and the 3.0 mafy reduction scenario (Columns A and B).
- The predicted reduction in stage for the existing coverage in Reaches 3 through 5 (1.574 mafy reduction in flow provided by the 2005 BO [USFWS 2005a], 2004 HCP [LCR MSCP 2004a] and 2022 BO [USFWS 2022]), which ranged from a minimum of 0.13 feet to a maximum of 3.08 feet, appears in Column C.
- The incremental predicted reduction in stage (1.574 mafy to 3.0 mafy) and the total predicted reduction in stage (0 mafy to 3.0 mafy) are provided in Columns D and E, respectively. The incremental predicted reduction in stage ranges from a minimum of 0.01 feet to a maximum of 1.38 feet. The total predicted reduction in stage ranges from a minimum of 0.22 feet to a maximum of 3.41 feet.
- The table then provides information on minimum river bottom elevation (Column F), average river bottom elevation (Column H), and the predicted depth of water for these two values under a 3.0 mafy reduction (Columns G and I).
    - The depth above the minimum river bottom elevation ranges from a minimum of 4.86 feet to a maximum of 33.06 feet.
    - The depth above the average river bottom elevation ranges from a minimum of 1.82 feet to a maximum of 17.13 feet.
    - The minimum depth above the average river bottom elevation occurs at river mile 109.1 where a large sandbar occurs in the middle of the river and skews the average river bottom elevation value. A similar situation exists at river mile 167.6 where a sandbar also skews the average river bottom elevation value.
    - At river mile 109.1, there is a deep channel on one side of the sandbar that is predicted to maintain approximately 11 feet of depth above the river bottom. Similarly, at river mile 167.6, the deep channel is predicted to maintain approximately 7 feet of depth above the river bottom. Without including the cross sections at river miles 109.1 and 167.6, the depth above the average river bottom elevation would range from a minimum of 2.92 feet instead of 1.82 feet. So, even during times of predicted minimum flow and stage during April, it is predicted that there will be at least 4.86 feet of water above the minimum river bottom elevation as modeled at the 33 cross sections.

Table 8-4. Changes in River Stage during April from Reductions in River Flow for an Annual Reduction in Flow of 3.0 maf

		A	B	C	D	E	F	G	H	I
Reach	**River Mile**	**Minimum Predicted Stage (feet): 2004 Baseline Scenario**	**Minimum Predicted Stage (feet): 3.0 mafy Reduction Scenario**	**Reduction in Stage (feet): 0 to 1.574 mafy**	**Incremental Reduction in Stage (feet): 1.574 to 3.0 mafy**	**Reduction in Stage (feet): 0 to 3.0 mafy**	**Minimum Elevation (feet): River Bottom**	**Depth of Water (feet): Minimum River Bottom– 3.0 mafy Reduction Scenario**	**Average Elevation (feet): River Bottom**	**Depth of Water (feet): Average River Bottom– 3.0 mafy Reduction Scenario**
3	270.5	496.59	494.42	-2.13	-0.04	-2.17	487.81	6.61	489.61	4.81
3	267.2	489.48	487.07	-2.36	-0.05	-2.41	482.21	4.86	483.46	3.61
3	262.9	477.13	473.99	-3.08	-0.06	-3.14	461.93	12.06	470.31	3.69
3	259.6	473.62	470.70	-2.86	-0.06	-2.92	459.79	10.91	464.02	6.68
3	255.1	468.53	465.40	-3.07	-0.06	-3.13	452.84	12.56	457.08	8.32
3	248.9	464.08	460.93	-2.24	-0.91	-3.15	450.75	10.18	453.65	7.28
3	243.9	458.54	455.16	-2.41	-0.98	-3.39	439.86	15.30	442.78	12.38
3	240.8	456.76	453.57	-2.26	-0.92	-3.18	442.13	11.44	444.18	9.39
3	237.6	454.02	451.17	-2.03	-0.81	-2.84	441.49	9.68	443.49	7.68
3	234.7	452.65	450.07	-1.78	-0.80	-2.58	441.64	8.43	444.64	5.43
3	229.8	450.21	447.99	-1.59	-0.62	-2.21	435.09	12.90	440.21	7.78
3	225	448.91	447.28	-1.18	-0.45	-1.63	429.57	17.71	436.08	11.20
3	220.2	447.61	446.65	-0.70	-0.26	-0.96	413.59	33.06	429.52	17.13
4	171.3	335.05	332.45	-2.46	-0.14	-2.60	322.46	9.99	326.38	6.07
4	167.6	328.67	325.86	-2.65	-0.15	-2.80	318.82	7.04	323.17	2.69
4	160.9	317.09	314.35	-2.58	-0.15	-2.73	307.31	7.04	310.46	3.89
4	149.5	299.89	297.13	-2.60	-0.17	-2.77	289.24	7.89	291.84	5.29
4	146.9	296.24	294.10	-2.01	-0.13	-2.14	284.29	9.81	289.62	4.48
4	135.8	283.97	283.65	-0.31	-0.01	-0.32	274.27	9.38	275.57	8.08
4	119.7	249.29	246.72	-1.54	-1.03	-2.57	240.25	6.47	242.28	4.44
4	116.5	243.28	239.87	-2.03	-1.38	-3.41	232.33	7.54	235.58	4.29
4	114.6	240.75	237.57	-1.87	-1.30	-3.17	226.30	11.27	233.32	4.25

		A	B	C	D	E	F	G	H	I
Reach	**River Mile**	**Minimum Predicted Stage (feet): 2004 Baseline Scenario**	**Minimum Predicted Stage (feet): 3.0 mafy Reduction Scenario**	**Reduction in Stage (feet): 0 to 1.574 mafy**	**Incremental Reduction in Stage (feet): 1.574 to 3.0 mafy**	**Reduction in Stage (feet): 0 to 3.0 mafy**	**Minimum Elevation (feet): River Bottom**	**Depth of Water (feet): Minimum River Bottom– 3.0 mafy Reduction Scenario**	**Average Elevation (feet): River Bottom**	**Depth of Water (feet): Average River Bottom– 3.0 mafy Reduction Scenario**
4(a)	109.1	232.23	229.06	-1.90	-1.27	-3.17	217.42	11.64	227.24	1.82
4	103.1	225.61	222.89	-1.65	-1.07	-2.72	213.89	9.00	218.49	4.40
4	96.7	217.27	214.09	-1.92	-1.26	-3.18	201.95	12.14	210.41	3.68
5	86.1	208.09	205.42	-1.43	-1.24	-2.67	192.82	12.60	202.50	2.92
5	80.4	202.97	200.72	-1.23	-1.02	-2.25	189.75	10.97	194.08	6.64
5	72.2	195.17	192.78	-1.32	-1.07	-2.39	183.10	9.68	189.15	3.63
5	70.3	194.13	191.71	-1.34	-1.09	-2.43	182.58	9.13	187.66	4.05
5	66.1	190.14	187.70	-1.39	-1.05	-2.44	179.00	8.70	183.72	3.98
5	56	184.88	182.73	-1.08	-1.08	-2.16	171.50	11.23	176.80	5.93
5	53.6	181.62	180.32	-0.73	-0.58	-1.31	171.51	8.81	172.81	7.51
5	50.8	179.81	179.60	-0.13	-0.09	-0.22	169.58	10.02	171.86	7.74

Figure 8-10 and Figure 8-11 show the flow routing from Davis Dam for both the baseline and the proposed expanded action scenario of 3.0 mafy reduction in flow. Figure 8-12 and Figure 8-13 show the flow routing from Parker Dam for both the baseline and the proposed expanded action scenario of 3.0 mafy reduction in flow.

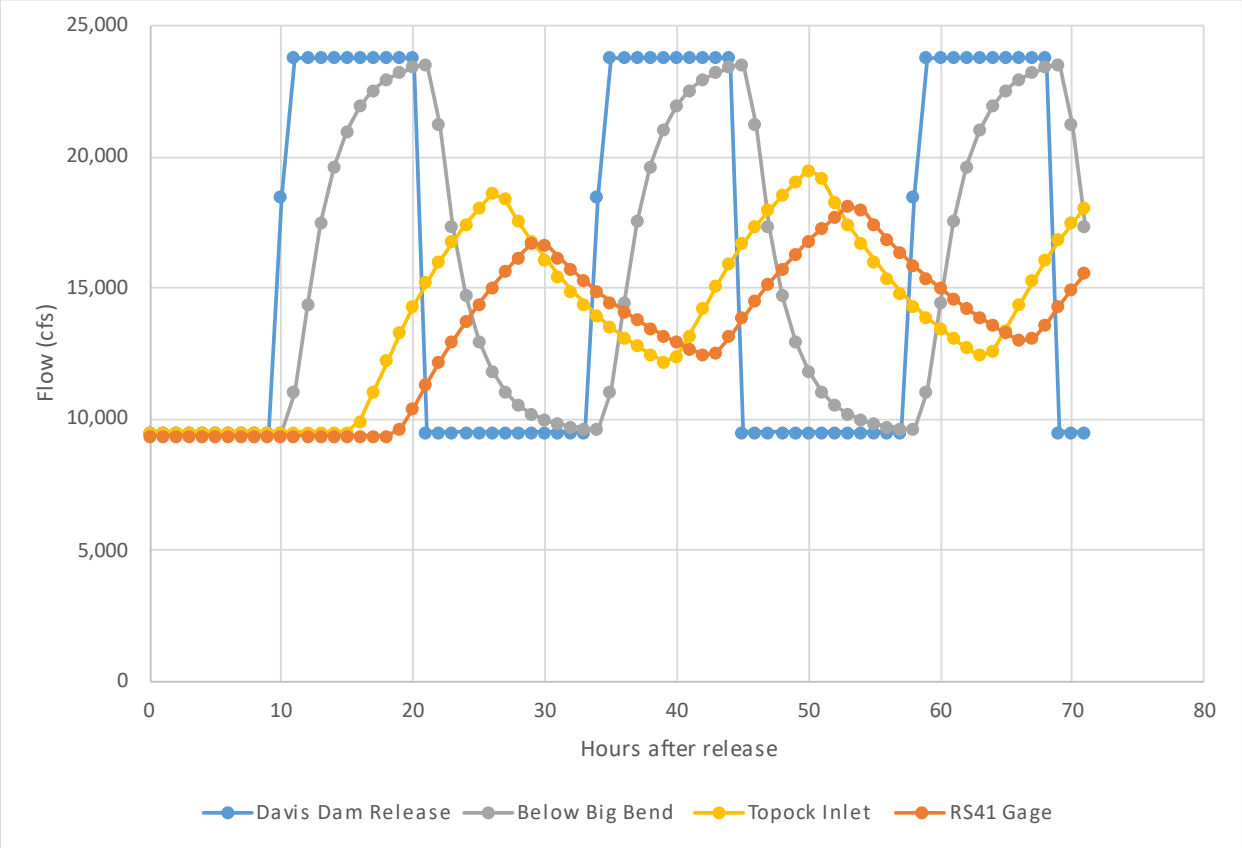


Figure 8-10. April flow routing for releases from Davis Dam, 2004 baseline scenario.

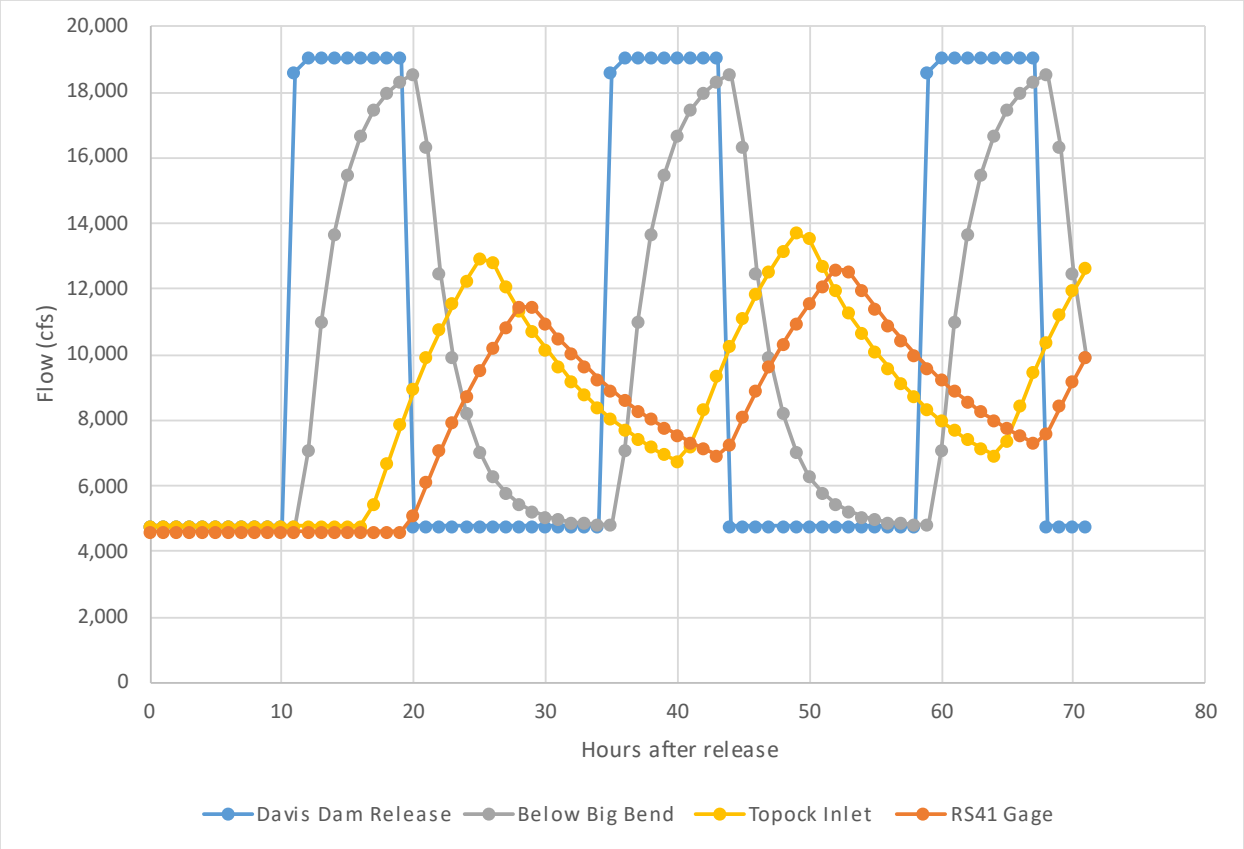


Figure 8-11. April flow routing for releases from Davis Dam, 3.0 mafy reduction scenario.

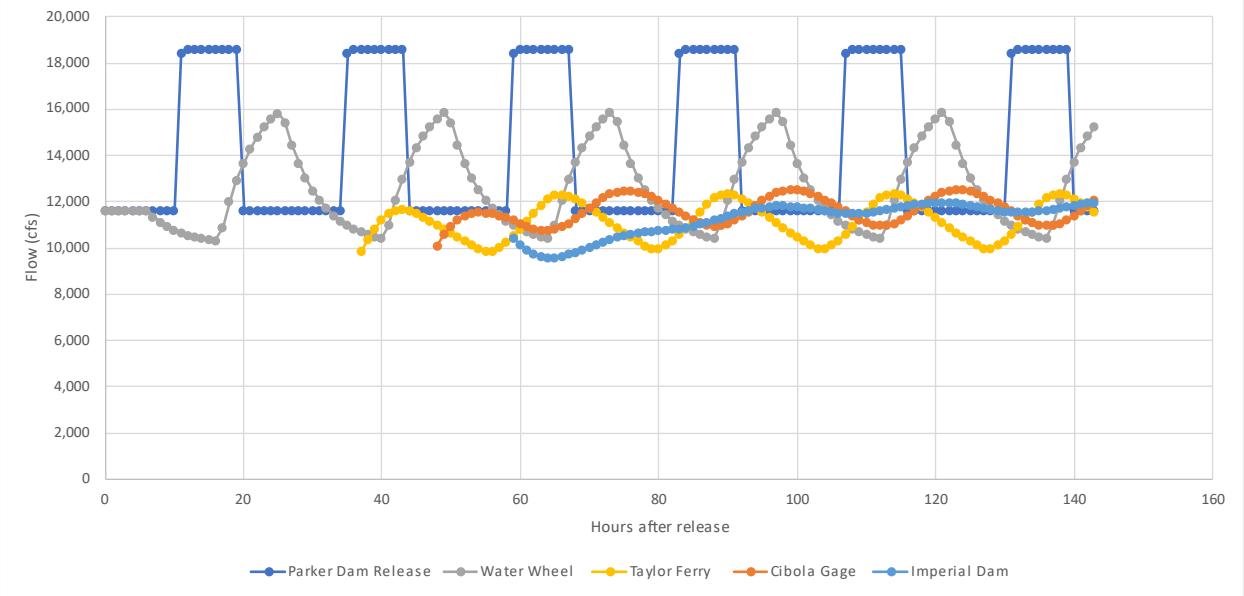


Figure 8-12. April flow routing for releases from Parker Dam, 2004 baseline scenario.

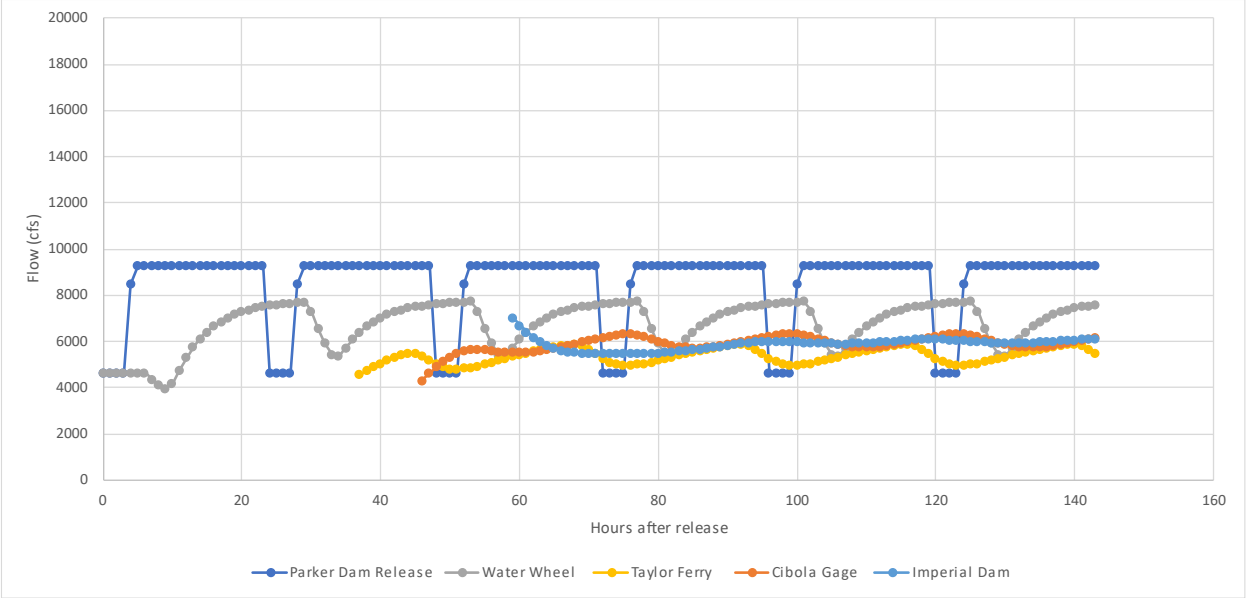


Figure 8-13. April flow routing for releases from Parker Dam, 3.0 mafy reduction scenario.

Table 8-5 and Table 8-6 show the predicted impacts to riverine, marsh, and backwater habitats as a result of reduced river stage due to the proposed expanded action. The methodology for predicting these impacts is described in Section K.1, Appendix K in LCR MSCP (2004c).

Table 8-5. Predicted Reduction in River Area Acres for April

Reach	Current River Area (acres, 2004 baseline)	Incremental Reduction in River Area (acres) 1.574 to 3.0 mafy	Total Reduction in River Area (acres) 0 to 3.0 mafy
3	3,585	11	71
4 and 5	10,303	65	214
Total	**13,888**	**76**	**285**

Table 8-6. Predicted Reduction in Backwater Area Acres for April

Reach	Current Total Backwater Area (acres, 2004 baseline)	Incremental Reduction in Backwater Emergent Area (acres) 1.574 to 3.0 mafy	Total Reduction in Backwater Emergent Area (acres) 0 to 3.0 mafy	Incremental Reduction in Backwater Open-Water Area (acres) 1.574 to 3.0 mafy	Total Reduction in Backwater Open-Water Area (acres) 0 to 3.0 mafy
3	3,289	14	45	5	15
4 and 5	7,234	70	179	44	112
Total	**10,523**	**84**	**224**	**49**	**127**

9 EFFECTS OF HYDROLOGICAL CHANGES ON HABITAT CONDITIONS

9.1 Base Action

This section describes the potential effects of the additional reduction in flow downstream of Hoover Dam on environmental conditions that provide habitat for covered species. Several assumptions were used in this analysis. Within the Colorado River floodplain, groundwater levels are directly correlated with the surface elevation of the Colorado River unless influenced by agricultural return flows. When Colorado River flows are reduced, groundwater elevations will also decrease, though timing of groundwater response is dependent on factors, such as distance from the river and soil conditions. Since backwater and marsh are adjacent to or near the river, surface elevation reductions were used to estimate impacts to riverine, backwater, and marsh habitats from the proposed action. A bank slope angle was used to transform the effects of the vertical reduction in river stage to a horizontal area of land cover. For backwaters, a bank slope angle of 30 degrees was assumed because it is consistent with the past approach, which yielded conservative (high-end) estimates of impacted acres (see Appendix K.2.2, Tables K1 and K2 in LCR MSCP 2004c). The change in water surface elevation was combined with the 2000 backwater mapping used in the 2004 analysis to determine the amount of additional land cover type impacted. Impacts from the increased reduction in flow could affect marsh, river, and backwater land cover.

Riparian Woodland: Almost all cottonwood-willow and honey mesquite existing and potential habitat (for the southwestern willow flycatcher, the western yellow-billed cuckoo, and the northern Mexican gartersnake) that will be affected was previously analyzed (see Section 4), and incidental take was issued and mitigation was established under the LCR MSCP (2005). An exception to this includes Topock Marsh which was excluded from impacted habitat based on the implementation of AMM2. Increased reduction in flow may temporarily affect this habitat at Topock Marsh due to delayed completion of projects related to full implementation of AMM2, which was designed to avoid impacts of flow-related covered activities on covered species habitats at Topock Marsh (see Section 5.5.2.1 of LCR MSCP 2004b). Due to various circumstances, the project has not been fully completed, but completion is scheduled for 2025 or 2026 and will involve pumped delivery of water to Topock Marsh, including during anticipated times of reduced flow and river stage. During the interim coverage period and prior to project completion, increased reductions in flow may affect USFWS' ability to deliver the required volume of water to fill Topock Marsh by the start of the breeding seasons.

Marsh: Emergent marsh provides habitat for the Yuma Ridgway's rail and northern Mexican gartersnake. The 2004 LCR MSCP analysis noted that reduced river water surface elevations may cause a change in marsh plant composition, conversion of marsh land cover to woody riparian land cover types, an increase in plant density and extent resulting in the loss of open water, and a change in marsh function. An increase in the range of daily fluctuations in surface water elevations in marshes resulting from the proposed action could also affect the quality of habitat provided for some covered species (see Section 5.2.3.3 of LCR MSCP 2004b).

Using identical methods as the 2004 LCR MSCP analysis described above, Reclamation combined the estimated reduction in stage with the 2000 backwater and marsh mapping data to estimate the effects of the increased reduction in flows from 1.574 mafy to 2.083 mafy on land cover types in Reaches 3 through 5. The results of the incremental analysis for this proposed action show that increasing the reduction in flow greater than 1.574 mafy to 2.083 mafy could impact an additional 6 acres of marsh in Reach 3 and an additional 35 acres of marsh in Reaches 4 and 5, representing 0.2% of existing marsh habitat in

Reach 3 and 0.75% of existing marsh habitat in Reaches 4 and 5. Total impacts from 0 mafy to 2.083 mafy reduction in flow is predicted to be 37 acres for Reach 3 and 143 acres in Reaches 4 and 5.

The proposed action may have additional, temporary impacts to 16 acres of marsh potential habitat (for the northern Mexican gartersnake and Yuma Ridgway's rail) at Topock Marsh due to delayed completion of projects related to full implementation of AMM2, which was designed to avoid impacts of flow-related covered activities on covered species habitats at Topock Marsh (see Section 4.5.28.1 of LCR MSCP 2020a). Due to various circumstances, the project has not been fully completed, but completion is scheduled for 2025 or 2026 and will involve pumped delivery of water to Topock Marsh, including during anticipated times of reduced flow and river stage. During the interim coverage period and prior to project completion, increased reductions in flow may affect USFWS' ability to deliver the required volume of water to fill Topock Marsh by the start of the breeding seasons.

River Conditions: The 2004 LCR MSCP analysis noted that reduction in hourly river flows may affect the river's edge, riffles, and side channels. Depending on site-specific channel morphology, reduced depths in association with ongoing daily flow fluctuations could cause stranding of juvenile or adult razorback suckers and bonytail, and desiccation of fish eggs and aquatic organisms in or on the substrate (see Section 5.2.3.5 of LCR MSCP 2004b).

The results of this incremental analysis, described above, show that decreases in water surface elevation could be up to an additional 0.48 feet in certain locations in Reach 3 and 0.81 feet in Reaches 4 and 5. The change in surface water area in response to reduced depth indicates that the change in river surface area would be relatively small (for greater than 1.574 mafy to 2.083 mafy, an additional 6 acres in Reach 3 and 40 acres in Reaches 4 and 5, representing 0.2% of the total river surface area in Reach 3 and 0.4% of the total river surface area in Reaches 4 and 5). Total impacts from 0 mafy to 2.083 mafy reduction in flow is predicted to be 65 acres for Reach 3 and 189 acres in Reaches 4 and 5. The level of existing stranding and desiccation and how flow variability at a lower surface elevation interacts with channel morphology are currently unknown.

Backwater: Open-water and emergent marsh provide habitat for the Yuma Ridgway's rail, northern Mexican gartersnake, bonytail, and razorback sucker. The 2004 LCR MSCP analysis noted that the change in river flow would affect backwater depth, surface area, flow continuity, and contaminant concentration. Reduced backwater depth, in combination with ongoing daily flow fluctuation, could increase stranding losses, displacement of small juveniles from nursery habitat and cover, and desiccation of aquatic organisms and fish eggs relative to the existing condition (see Section 5.2.3.6 of LCR MSCP 2004b).

The results of the incremental analysis (increasing coverage from a 1.574 mafy to 2.083 mafy reduction in flow), as described above, show that the change in surface area in backwaters in response to reduced depth would be small relative to the total area. An additional 8 acres would be impacted in Reach 3 and an additional 56 acres would be impacted in Reaches 4 and 5 (64 acres total), which represents about 0.24% of the total area of backwaters in Reach 3 (3,289 acres) and 0.77% of the total area of backwaters in Reaches 4 and 5 (7,234 acres). Total impacts from the 0 mafy to 2.083 mafy reduction in flow is predicted to be 49 acres in Reach 3 and 233 acres in Reaches 4 and 5. Reduced river flow may affect contaminant concentrations in connected backwaters. Effects depend on currently undocumented site-specific channel morphology.

Backwater habitats established at CHLP and the Big Bend, Mohave Valley, Section 26, and Imperial Ponds Conservation Areas could be affected by flow reductions. Daily river fluctuation and reduced backwater depth could displace early life stage native fishes from nursery habitat and cover, and desiccation of fish eggs could increase relative to the existing condition in CHLP. An additional reduction in flow could impact 0.43 acre of open water backwater habitat at CHLP. Reduced river stage is expected

to have minimal impacts on connected backwaters at the Big Bend, Mohave Valley, and Section 26 Conservation Areas (impacting 7.33 acres of open backwater), and any impacts will be addressed through avoidance and minimization measures. Reduction in flow could impact 2 acres of backwater habitat at the IPCA. Increased reduction in flow and the resulting backwater habitat acres impacted are not expected to reduce the carrying capacity of these habitats.

Reservoir (Lake Mead): The range of potential hydrology scenarios modeled under the proposed action alternative (see Figure 2-2) would not result in lake elevations or fluctuations outside of those observed over the last 18 years. While spawning habitat for razorback suckers has been periodically affected by changes in lake elevation over this period, razorback suckers have successfully moved their spawning locations to adjacent areas at progressively lower elevations as the lake receded and have moved back to previously used spawning locations in years when lake elevation increased. Impacts to habitat occupied by humpback chub are also expected to be minor. An approximately 15-mile section of transitory river habitat would be affected by the proposed action, but relatively few humpback chub have been captured or contacted in this area. The proposed action would not affect Lake Mead beyond the effects already analyzed in the original LCR MSCP, i.e., the periodic loss and gain of habitat at different lake elevations.

9.2 Expanded Action

The proposed expanded action will have similar effects on habitat conditions as the proposed base action, only differing in the magnitude of these effects. These effects are summarized below:

Riparian Woodland: No additional effects on riparian woodland habitat are expected from the proposed expanded action when compared to the proposed base action.

Marsh: The results of the incremental analysis for the proposed expanded action show that increasing the reduction in flow from 2.083 mafy to 3.0 mafy could impact 8 additional acres of marsh in Reach 3 and an additional 36 acres of marsh in Reaches 4 and 5, representing 0.32% of existing marsh habitat in Reach 3 and 0.80% of existing marsh habitat in Reaches 4 and 5. Total impacts from the 0 mafy to 3.0 mafy reduction in flow is predicted to be 45 acres for Reach 3 and 179 acres in Reaches 4 and 5.

River Conditions: The results of the incremental analysis for the proposed expanded action show that increasing the reduction in flow from 2.083 mafy to 3.0 mafy could result in decreases in water surface elevation up to an additional 0.50 feet in Reach 3 and an additional 0.57 feet in Reaches 4 and 5. Between the 2.083 mafy scenario and the 3.0 mafy scenario, the change in surface water area in response to reduced depth indicates that the change in river surface area would be relatively small (5 additional acres in Reach 3 and 25 additional acres in Reaches 4 and 5, representing 0.14% of the total river surface area in Reach 3 and 0.24% of the total river surface area in Reaches 4 and 5). Total impacts from the 0 mafy to 3.0 mafy reduction in flow are predicted to be 71 acres for Reach 3 and 214 acres in Reaches 4 and 5. The level of existing stranding and desiccation and how flow variability at a lower surface elevation interacts with channel morphology are currently unknown.

Backwater: The results of the incremental analysis for the proposed expanded action (increasing the reduction in flow from 2.083 mafy to 3.0 mafy) show that the change in backwater surface area in response to the reduced depth would be small relative to the total area. An additional 11 acres would be impacted in Reach 3 and an additional 58 acres would be impacted in Reaches 4 and 5 (69 acres total), which represents about 0.33% of the total area of backwaters in Reach 3 (3,289 acres) and 0.80% of the total area of backwaters in Reaches 4 and 5 (7,234 acres). Total impacts from the 0 mafy to 3.0 mafy reduction in flow is predicted to be 60 acres in Reach 3 and 291 acres in Reaches 4 and 5. Reduced river flow may affect contaminant concentrations in connected backwaters. Effects depend on currently undocumented site-specific channel morphology.

Reservoir (Lake Mead): No additional effects on Lake Mead are expected from the proposed expanded action when compared to the proposed base action.

10 EFFECTS ON SEVEN THREATENED AND ENDANGERED SPECIES

10.1 Northern Mexican Gartersnake

Implementation of the increased reduction in flow is likely to adversely affect the northern Mexican gartersnake through effects on suitable habitat during the period of the proposed action. Conservation measures listed in the 2004 HCP (LCR MSCP 2004a), 2018 BO (USFWS 2018a), 2022 BO (USFWS 2022), and this consultation will avoid, minimize, and mitigate the direct effects of implementing the reduction in flow on the northern Mexican gartersnake.

10.1.1 Effects of Increased Reduction in Flow

Increased reduction in flow may result in take of the northern Mexican gartersnake through impacts to its habitat.

Reduced flow will lower surface water elevations in inundated areas and reduce groundwater levels during the periods of lowest flow resulting in a reduction in the size of backwaters with emergent marsh in Reaches 3 through 5. Up to 6 acres of marshes associated with backwaters along the river in Reach 3 and 35 acres of backwater emergent vegetation in Reaches 4 and 5 may be impacted under the proposed base action. Up to an additional 8 acres of marshes associated with backwaters along the river in Reach 3 and 35 additional acres of backwater emergent vegetation in Reaches 4 and 5 may be impacted under the proposed expanded action compared to the proposed base action.

This may cause direct loss of vegetation through desiccation, and the fragmentation or reduction in the extent of habitat patches. This may lead to loss of vegetative cover used during foraging, refuge, and thermoregulation along the edges of these habitat patches, and changes to habitat used by prey. Loss of marsh habitat may result in non-lethal take due to the stress of using changing habitat or marginally suitable habitat. It is not anticipated that there will be a reduction in the amount of prey available as the amount of habitat reduction at each location will be small and some vegetation impacts may be offset if portions of the open water at these locations become shallow enough to allow for marsh vegetation to grow (this potential offsetting condition has not been included in the calculation of the impacted acreage totals listed above).

There may be a decrease in the size of the inundated area of Topock Marsh and groundwater and wet surface soils supported by the marsh if Topock Marsh elevations drop during spring and summer due to reduction or delays in water deliveries. This may result in degradation of an estimated 133 acres of cottonwood-willow habitat and 16 acres of marsh habitat along Topock Marsh. The 984 acres of cottonwood-willow habitat adjacent to emergent marsh vegetation that may support northern Mexican gartersnakes in other portions of the river may also be affected but were previously assessed and mitigated through a conservation measure NMGS1 to create and manage 984 acres of cottonwood-willow land cover for northern Mexican gartersnakes under the 2018 BO (USFWS 2018a) and HCP Amendment (Reclamation 2018b). Degradation of cottonwood-willow habitat may lead to loss of vegetative cover used for refuge and thermoregulation and a reduction in the type or quality of the vegetation at burrows and hibernacula sites. This may result in those areas no longer being suitable while the degraded habitat conditions persist. A reduction in the quality of the cottonwood-willow habitat may also result in a change

in the type and quantity of upland prey available if the habitat supports less prey or different species. Reduction in habitat quality and prey may result in non-lethal take due to the stress of having to use changing habitat or marginally suitable habitat and increased foraging activity due to a shifting prey-base. Non-lethal take may also occur through increased northern Mexican gartersnake energy expenditures due to the need to seek out new burrow or hibernacula sites and sufficient thermoregulatory cover. This additional stress and energy expenditure may reduce fecundity and alter activity patterns making them susceptible to additional predation.

Reservoir elevations in Reach 3 would not be affected by lower river stage elevations. Consequently, the increased reduction in flow is not expected to affect habitat associated with marshes maintained by reservoirs (e.g., Bill Williams River Delta in Reach 3).

10.1.2 Effects on Critical Habitat

On April 28, 2021, the USFWS designated critical habitat for the northern Mexican gartersnake. The increased reduction in flow and conservation measures will have no effect on critical habitat as there is no designated critical habitat within the action area. The conservation measures will ensure that the created and managed habitat established under the LCR MSCP contain the physical and biological features for the northern Mexican gartersnake and that effects to the existing physical and biological features at Topock Marsh are minimized.

10.1.3 Conservation Measures

The following conservation measures are new and will be implemented as part of the proposed base and expanded action (if necessary).

10.1.3.1 BASE ACTION

1. 2024NMGS1 – Create 41 acres of northern Mexican gartersnake habitat.
2. 2024AMM1 – Minimize the impacts of reduced river stage on covered species habitats at Topock Marsh due to delayed completion of projects related to full implementation of AMM2.
3. 2024MRM2 – Collect necessary data needed for future consultations and update existing methodologies with new information.
4. 2024MRM3 – Conduct research on northern Mexican gartersnake habitat use.

10.1.3.2 EXPANDED ACTION

1. 2024AMM5 – Enhance northern Mexican gartersnake, Yuma Ridgway's rail, southwestern willow flycatcher habitat at Planet Ranch.
2. 2024AMM6 – Collaborate with mainstem NWRs to enhance and protect existing habitat areas.

10.1.4 Effects of Conservation Measure Implementation

10.1.4.1 BASE ACTION

Implementation of the conservation measures, including creation of 41 acres of additional habitat (2024NMGS1), achieves the LCR MSCP goal to avoid, minimize, and fully mitigate adverse effects of covered activities and LCR MSCP implementation on the northern Mexican gartersnake and to contribute to its recovery. Implementation of these measures will help ensure that the existing abundance of the species in the LCR MSCP planning area is maintained as a result of fully replacing affected habitat and

maintaining existing habitat that otherwise could decline in function or be lost without management intervention.

Under the base action, 2024AMM1 would ensure that water deliveries to Willow Marsh at Beal Lake Conservation Area are prioritized, and any potential habitat disturbances are postponed, ensuring that the quantity and quality of this occupied patch of habitat is retained, thereby avoiding displacement and additional energy expenditures by resident northern Mexican gartersnakes and the associated affects. Under 2024AMM1, water will also be pumped to cottonwood-willow habitat at Topock Marsh that is occupied by northern Mexican gartersnakes to maintain the quantity and quality of those habitat patches, avoiding displacement and additional energy expenditures by resident northern Mexican gartersnakes and the associated affects.

Under 2024MRM2, monitoring and research will be conducted to address future assessments of impacts to northern Mexican gartersnakes. A more accurate impact assessment would be aided by this conservation measure under which Reclamation would use recent bathymetry and new vegetation classification data in the habitat impact models. More accurate habitat models will allow for appropriate mitigation for future water management actions.

Under 2024MRM3, research would be conducted on the spatial and temporal use of habitat by the NMGS on the lower Colorado River. This would enable Reclamation to better evaluate the impacts in future consultations and assist the LCR MSCP in designing, creating, and managing NMGS habitat.

10.1.4.2 EXPANDED ACTION

Under 2024AMM5, all or a portion of the annual water entitlement at Planet Ranch would be used to maintain and enhance cottonwood-willow habitat and existing marsh habitats downstream of the constructed backwaters at Planet Ranch. This would provide potential habitat for the Bill Williams River population of the northern Mexican gartersnake on Planet Ranch that were farm fields and native habitat on the eastern end of the Bill Williams NWR in an area that has been degraded due to insufficient water. Under 2024AMM6, Reclamation would collaborate with NWRs along the Colorado mainstem to enhance and protect existing marshes. This would increase the quality of available potential habitat for northern Mexican gartersnakes outside conservation areas.

10.2 Yuma Ridgway's Rail

Implementation of the increased reduction in flow is likely to adversely affect the Yuma Ridgway's rail through effects on suitable habitat during the period of the proposed action. Conservation measures listed in the 2004 HCP (LCR MSCP 2004a), the 2022 BO (USFWS 2022), and this consultation will avoid, minimize, and mitigate the direct effects of implementing the reduction in flow on the Yuma Ridgway's rail.

10.2.1 Effects of Increased Reduction in Flow

Increased reduction in flow may result in take of the Yuma Ridgway's rail.

Reduced flow will lower surface water elevations during periods of lowest flow resulting in a reduction in the size of marshes and backwaters with emergent marsh vegetation in Reaches 3 through 5. This may reduce the extent or quality of 6 acres of Yuma Ridgway's rail habitat provided by marshes associated with backwaters in Reach 3 and 35 acres in Reaches 4 and 5 under the proposed base action. This may reduce the extent or quality of up to 8 additional acres of Yuma Ridgway's rail habitat provided by

marshes associated with backwaters in Reach 3 and an additional 35 acres in Reaches 4 and 5 under the proposed expanded action compared to the proposed base action.

This may cause direct loss of vegetation through desiccation, and the fragmentation or reduction in the extent of habitat patches. Loss of marsh habitat would result in an adverse effect on Yuma Ridgway's rail due to the stress of using changing habitat or marginally suitable habitat and associated increased difficulties in nesting or finding suitable quantity and quality of prey, or the stress of habitat abandonment. Adverse effects could include shortened life spans resulting in mortality due to the stress, as well as potentially lower fecundity and lower egg output, lower young survivability, or nest abandonment. It is not anticipated that there will be an overall reduction in the amount of prey available as the amount of habitat reduction at each location will be small and some vegetation impacts may be offset if portions of the open water at these locations become shallow enough to allow for marsh vegetation to grow (this potential offsetting condition has not been included in the calculation of the impacted acreage totals listed above).

There may be a decrease in the size of the inundated area of Topock Marsh and groundwater and wet surface soils supported by the marsh if Topock Marsh elevations drop during spring and summer due to reduction or delays in water deliveries. This may result in degradation of 16 acres of marsh habitat along Topock Marsh. Similar impacts as described above may occur in these estimated 16 acres.

Reservoir elevations in Reach 3 would not be affected by lower river stage elevations. Consequently, increased reduction in flow is not expected to affect habitat associated with marshes maintained by reservoirs (e.g., Bill Williams River Delta).

10.2.2 Effects on Critical Habitat

No critical habitat has been designated for Yuma Ridgway's rail; therefore, none will be affected by the proposed action.

10.2.3 Conservation Measures

The following Conservation Measures are new and will be implemented as part of the proposed action.

10.2.3.1 BASE ACTION

1. 2024CLRA1 – Create 41 acres of Yuma Ridgway's rail habitat. [16]
2. 2024AMM1 – Minimize the impacts of reduced river stage on covered species habitats at Topock Marsh due to delayed completion of projects related to full implementation of AMM2.
3. 2024MRM2 – Collect necessary data needed for future consultations and update existing methodologies with new information.

10.2.3.2 EXPANDED ACTION

1. 2024AMM5 – – Enhance northern Mexican gartersnake, Yuma Ridgway's rail, southwestern willow flycatcher habitat at Planet Ranch.
2. 2024AMM6 – Collaborate with mainstem NWRs to enhance and protect existing habitat areas.

[16] Minor Modification to language in CLRA1 was approved by the Steering Committee 4-22-2020 (Final Motion20-003 FinalPDD20-002). Minor Modification was approved by the USFWS in letter dated May 21, 2020.

10.2.4 Effects of Conservation Measure Implementation

10.2.4.1 BASE ACTION

Implementation of the conservation measures, including creation of 41 acres of additional habitat (2024CLRA1), achieves the LCR MSCP goal to avoid, minimize, and fully mitigate adverse effects of covered activities and LCR MSCP implementation on the Yuma Ridgway's rail and to contribute to its recovery. Implementation of these measures will help ensure that the existing abundance of the species in the LCR MSCP planning area is maintained as a result of fully replacing affected habitat and maintaining existing habitat that otherwise could decline in function or be lost without management intervention.

Under the base action, 2024AMM1 would ensure that water deliveries to Topock Marsh are not significantly impacted by reductions in flow. These water deliveries would protect the 16 acres of potential Yuma Ridgway's rail habitat at Topock Marsh.

Under 2024MRM2, monitoring and research will be conducted to address future assessments of impacts to Yuma Ridgway's rails. A more accurate impact assessment would be aided by this conservation measure under which Reclamation would use recent bathymetry and new vegetation classification data in the habitat impacts models. More accurate habitat models will allow for appropriate mitigation for future water management actions.

10.2.4.2 EXPANDED ACTION

Under 2024AMM5, all or a portion of the annual water entitlement at Planet Ranch would be used to maintain and enhance existing marsh habitats downstream of the constructed backwaters at Planet Ranch. These beaver ponds and seeps have been degraded due to insufficient water and have been used by Yuma Ridgway's rails. Under 2024AMM6, Reclamation would collaborate with NWRs along the Colorado mainstem to enhance and protect existing marshes. This would increase the quality of available habitat for Yuma Ridgway's rails outside conservation areas.

10.3 Southwestern Willow Flycatcher

Implementation of the increased reduction in flow is likely to adversely affect the southwestern willow flycatcher during the period of the proposed action. Conservation measures listed in the 2004 HCP (LCR MSCP 2004a) and this consultation will avoid, minimize, and mitigate the direct effects of implementing the reduction in flow on the southwestern willow flycatcher.

10.3.1 Effects of Increased Reduction in Flow

Implementation of the increased reduction in flow is likely to adversely affect the southwestern willow flycatcher. Almost all cottonwood-willow and honey mesquite existing and potential habitat for the southwestern willow flycatcher that will be affected was previously analyzed (see Section 4) and incidental take was issued and mitigation was established under the LCR MSCP (2005). An exception to this includes Topock Marsh, which was excluded from impacted habitat based on the implementation of AMM2. Increased reduction in flow may temporarily affect 10.9 acres of southwestern willow flycatcher breeding sites at Topock Marsh due to delayed completion of projects related to full implementation of AMM2, which was designed to avoid impacts of flow-related covered activities on covered species habitats at Topock Marsh (see Section 5.5.2.1 of LCR MSCP 2004b). Nesting habitat within the action area is present only at Topock Marsh.

Under AMM2, Reclamation is collaborating with the Havasu NWR to maintain continued water deliveries to Topock Marsh for the benefit of the southwestern willow flycatcher. If Topock Marsh elevations drop during spring and summer due to reduction coinciding with AMM2 repairs to the water delivery system to Topock Marsh, there may be a reduction in surface wet conditions at occupied breeding territories, which may result in degradation (e.g., less foliage, terminal dieback, death) of the cottonwood-willow habitat. Without minimization measures, habitat degradation may reduce the number of breeding territories and reduced nest success where nesting attempts occur in areas with insufficient vegetation cover to hide nests and moderate temperatures at nests. The number of breeding territories varies yearly. There were three territories in 2021, with one nest successfully fledgling young.
An estimated 133 acres of cottonwood-willow habitat along Topock Marsh may be degraded if Topock Marsh elevations drop during spring and summer. These 133 acres represent the flycatcher survey sites that are monitored under the LCR MSCP and are evaluated annually for habitat suitability. The most recent surveys documented that only three sites (Hell Bird, 800M, and Lost Lake Slough 03) were occupied, representing 10.9 acres (McLeod and Pellegrini 2022).

The increased reduction in flows would not affect riparian areas in the Bill Williams River Delta because Lake Havasu pool elevations will not be affected by the reduction in flow. The Bill Williams River Delta was burned in the 2021 Planet Ranch Fire and does not currently provide suitable flycatcher habitat; however, the area could provide suitable flycatcher habitat in the future if the native riparian vegetation regrows. In total, 1,853 acres of cottonwood-willow habitat that may support southwestern willow flycatchers in other portions of the river outside LCR MSCP conservation areas may also be affected but were previously assessed and are covered under the 2004 HCP (LCR MSCP 2004a). The conservation measure is WIFL1: to create and manage 5,940 acres of cottonwood-willow, with at least 4,050 acres to be designed and created to provide habitat for this species.

10.3.2 Effects on Critical Habitat

No designated critical habitat for the southwestern willow flycatcher is present in the action area; thus, there will be no effect on critical habitat. The conservation measures will ensure that effects to the existing physical and biological features at Topock Marsh are minimized.

10.3.3 Conservation Measures

The following conservation measures are new and will be implemented as part of the proposed action.

10.3.3.1 BASE ACTION

1. 2024AMM1 – Minimize the impacts of reduced river stage on covered species habitats at Topock Marsh due to delayed completion of projects related to full implementation of AMM2.
2. 2024MRM2 – Collect necessary data needed for future consultations and update existing methodologies with new information.

10.3.3.2 EXPANDED ACTION

1. 2024AMM5 – Enhance northern Mexican gartersnake, Yuma Ridgway's rail, southwestern willow flycatcher habitat at Planet Ranch.
2. 2024AMM6 – Collaborate with mainstem NWRs to enhance and protect existing habitat areas.

10.3.4 Effects of Conservation Measure Implementation

10.3.4.1 BASE ACTION

Under 2024AMM1, water will be pumped to cottonwood-willow habitat at Topock Marsh (Hell Bird, Glory Hole [Farm Ditch Road], 800M, and Lost Lake Slough) that is occupied by southwestern willow flycatchers to maintain the quantity and quality of those habitat patches, avoiding a reduction in nesting success and fledgling rates.

One monitoring and research measure—2024MRM2—would address future assessments of impacts to southwestern willow flycatchers. Under 2024MRM2, Reclamation would complete a basin-wide vegetation classification. Updated habitat classification will allow for a more accurate assessment of the current extent of possible flycatcher habitat.

10.3.4.2 EXPANDED ACTION

Implementation of the conservation measures will benefit the southwestern willow flycatcher by maintaining and enhancing cottonwood-willow areas downstream of the backwaters at Planet Ranch and contributing to habitat restoration at the Bill Williams River and Havasu NWRs. Two avoidance and minimization measures—2024AMM5 and 2024AMM6—would provide beneficial effects on southwestern willow flycatchers. Under 2024AMM5, all or a portion of the water entitlement at Planet Ranch would be used to maintain and enhance cottonwood-willow habitat and existing marsh habitats downstream of the constructed backwaters at Planet Ranch. This would maintain and enhance potential breeding habitat on Planet Ranch on the former farm fields and the native habitat on the eastern end of the Bill Williams NWR in an area that has been degraded due to insufficient water. Under 2024AMM6, Reclamation would collaborate with NWRs along the Colorado mainstem to enhance and protect existing riparian woodland habitat. Under this avoidance and minimization measure, Reclamation could provide riparian planting materials to promote recovery of the Bill Williams River Delta and Havasu NWR, which would benefit the flycatcher.

10.4 Western Yellow-Billed Cuckoo

Implementation of the increased reduction in flow is likely to adversely affect the western yellow-billed cuckoo through effects on suitable breeding habitat during the period of the proposed action. Conservation measures listed in the 2004 HCP (LCR MSCP 2004a) and this consultation will avoid, minimize, and mitigate the direct effects of implementing the reduction in flow on the western yellow-billed cuckoo.

10.4.1 Effects of Increased Reduction in Flow

Implementation of the increased reduction in flow may result in take of western yellow-billed cuckoos. Almost all cottonwood-willow and honey mesquite existing and potential habitat for the western yellow-billed cuckoo that will be affected was previously analyzed (see Section 4), and incidental take was issued and mitigation was established under the LCR MSCP (2005). An exception to this includes Topock Marsh, which was excluded from impacted habitat based on the implementation of AMM2. Increased reduction in flow may temporarily affect 133 acres of potential cottonwood-willow habitat at Topock Marsh due to delayed completion of projects related to full implementation of AMM2 which was designed to avoid impacts of flow-related covered activities on covered species habitats at Topock Marsh (see Section 5.5.14.1 of LCR MSCP 2004b).

Most western yellow-billed cuckoos in the action area are found on LCR MSCP conservation areas and on the Bill Williams River and its tributaries, which would not be affected by the proposed action (Southern Sierra Research Station *in press*). Reclamation's conservation areas with cottonwood-willow land cover within the action area support nesting western yellow-billed cuckoos and would not be affected by the proposed action. The increased reduction in flows would not affect riparian areas in the Bill Williams River Delta because Lake Havasu pool elevations will not be affected by the reduction in flow. The Bill Williams River Delta was burned in the 2021 Planet Ranch Fire and does not currently provide suitable western yellow-billed cuckoo habitat; however, the area could provide suitable western yellow-billed cuckoo habitat in the future if the native riparian vegetation regrows.

In total, 1,534 acres of cottonwood-willow habitat that may support western yellow-billed cuckoos outside the LCR MSCP conservation areas may be affected but those impacts were previously assessed and mitigation was agreed to in the 2004 HCP (LCR MSCP 2004a). The conservation measure is YBCU1: to create and manage 5,940 acres of cottonwood-willow, with at least 4,050 acres to be designed and created to provide habitat for this species.

Degradation of habitat may result in adverse effects on western yellow-billed cuckoos. Western yellow-billed cuckoos nest in dense stands, so degradation of the vegetation is likely to reduce the number of breeding territories and reduce nest success where nesting attempts occur in areas with insufficient vegetation cover to hide nests and moderate temperatures at nests. Habitat degradation may also result in increased energy expenditures of western yellow-billed cuckoos searching for alternate breeding sites at the beginning of nesting season or after nests fail. Habitat degradation may also result in stress from using changing habitat or marginally suitable habitat and associated increased difficulties in finding suitable quantity and quality of prey. This could result in shortened life spans resulting in mortality due to the stress, as well as potentially lower fecundity and lower egg output, lower young survivability, or nest abandonment.

10.4.2 Effects on Critical Habitat

No designated critical habitat for the western yellow-billed cuckoo is present in the action area; thus, there will be no effect on critical habitat. The conservation measures will ensure that effects to the existing physical and biological features at Topock Marsh are minimized.

10.4.3 Conservation Measures

10.4.3.1 BASE ACTION

1. 2024AMM1 – Minimize the impacts of reduced river stage on covered species habitats at Topock Marsh due to delayed completion of projects related to full implementation of AMM2.
2. 2024MRM2 – Collect necessary data needed for future consultations and update existing methodologies with new information.

10.4.3.2 EXPANDED ACTION

1. 2024AMM6 – Collaborate with mainstem NWRs to enhance and protect existing habitat areas.

10.4.4 Effects of Conservation Measure Implementation

10.4.4.1 BASE ACTION

Under 2024AMM1, water will be pumped to cottonwood-willow habitat at Topock Marsh (Hell Bird, Glory Hole [Farm Ditch Road], 800M, and Lost Lake Slough), that is potential habitat for the western yellow-billed cuckoo to maintain the quantity and quality of those habitat patches.

One monitoring and research measure—2024MRM2—would address future assessments of impacts to western yellow-billed cuckoos. Under 2024MRM2, Reclamation would complete a basin-wide vegetation classification. Updated habitat classification will allow for a more accurate assessment of the current extent of possible western yellow-billed cuckoo habitat.

10.4.4.2 EXPANDED ACTION

Under 2024AMM6, Reclamation would collaborate with NWRs along the Colorado mainstem to enhance and protect existing riparian woodland habitat. Under this avoidance and minimization measure, Reclamation could provide riparian planting materials to promote recovery of the Bill Williams River Delta and Havasu NWR, which would benefit the western yellow-billed cuckoo.

10.5 Humpback Chub

Implementation of the increased reduction in flow is likely to adversely affect humpback chub in Reach 1, downstream of the Pearce Ferry Rapid, during the period of the proposed action. Conservation measures listed in this consultation and in the LCR MSCP HCP (LCR MSCP 2004a), will support research and monitoring efforts that could support a better understanding of 1) the population dynamics of humpback chub downstream of Separation Canyon, and 2) the potential for movement of nonnative fishes from below Pearce Ferry rapid into the Grand Canyon. Information gathered through these efforts would be used to inform any future consultations.

There is no habitat for humpback chub in Reaches 2 through 5.

10.5.1 Effects of Increased Reduction in Flow

In 2004, it was assumed that based on recovery efforts for humpback chub upstream of Lake Mead, that humpback chub could occur in up to an estimated 62 miles of transitory Colorado River segments that could form within the full-pool elevation of Lake Mead if reservoir elevation was lowered to 950 feet. At that time, this portion of the action area was not known to support a population of humpback chub (USFWS 2005) and it was assumed that implementation of LCR MSCP covered activities had the potential to only affect a relatively small number of individuals that may use this transitory habitat when it was present in Lake Mead. The elevation of Lake Mead has generally declined since 2005, and these lower elevations have created approximately 55 miles of transitory riverine habitat from Separation Canyon (~240 river miles DGCD) to the Colorado River interface with Lake Mead (~295 river miles DGCD). At elevations below approximately 1,090 feet, this 55-mile stretch of river is segmented into two reaches by the Pearce Ferry Rapid (~280.5 river miles DGCD), which is a barrier to upstream movement of fishes (from Lake Mead to the Grand Canyon) at these elevations. Van Haverbeke et al. (2022) estimated ~24,000 adult humpback chub upstream of the rapid, i.e., from Diamond Creek to Pearce Ferry, and Fonken et al. (2023) captured 2,248 unique humpback chub in this same stretch of river from 2016 through 2022. Conversely, relatively few humpback chub (< 30) have been captured or contacted

downstream of the rapid each year since 2017 (Kegerries et al. 2017, 2018, 2019, 2021; Rogers et al. 2021, 2022a; Rogowski et al. 2022).

The LCR MSCP included the effects of future flow-related covered activities, including reductions in flow from Hoover Dam, on Lake Mead water surface elevations from full pool down to a water surface elevation of 950 feet. The purpose of the proposed action (reduction in flows in Reaches 2 through 5) is to increase storage (and reservoir elevations) in Lake Mead and will not result in reservoir elevations outside of those previously analyzed (950 feet to full pool at 1,229 feet). Because reservoir fluctuations would still occur under the proposed action within this range, the increase in flow reductions would not have an effect above the effects already analyzed in the original LCR MSCP. The status of humpback chub within the action area has however changed since this original analysis. The emergent population of humpback chub upstream of the Pearce Ferry Rapid is now considerably larger than what was considered probable under previous scenarios. This is likely due to the success of the humpback chub source population in the Little Colorado River and prolonged drought conditions that have supported the long-term presence of transitory riverine habitat downstream of Separation Canyon. As previously stated, the Pearce Ferry Rapid is a barrier to upstream movement of fishes at reservoir elevations below approximately 1,090 feet. The proposed action has a low probability of resulting in reservoir elevations above 1,090 feet (see Figure 2-2), which would continue to prevent upstream movement of nonnative, predatory fishes into the portion of the Grand Canyon within the action area (Separation Canyon to Pearce Ferry). There is also no risk of stranding, desiccation, or entrainment of humpback chub, nor is any habitat affected above the Pearce Ferry Rapid, as the Grand Canyon will not be affected by this action. Implementation of the increased reduction in flow would not affect humpback chub upstream of the Pearce Ferry Rapid.

Implementation of the increased reduction in flow downstream of Hoover Dam may result in take of humpback chub downstream of the Pearce Ferry Rapid. The purpose of the proposed action is to increase storage and reservoir elevations in Lake Mead, which may affect approximately 15 miles of existing transitory riverine habitat and other potential habitat, a portion of which is currently occupied by humpback chub. The periodic loss and replacement of this habitat was previously analyzed, and the effect of the proposed, short-term action is not expected to be greater than what was anticipated in 2005 due to the relatively few humpback chub individuals that have been documented using this habitat.

10.5.2 Effects on Critical Habitat

No designated critical habitat for the humpback chub is present in the action area; thus, there will be no effect on critical habitat.

10.5.3 Conservation Measures

The following conservation measure is a continuation of an existing conservation measure and will be implemented as part of the proposed action.

10.5.3.1 BASE ACTION

1. 2024HUCH1—Provide funding to support existing humpback chub conservation programs.

10.5.4 Effects of Conservation Measure Implementation

10.5.4.1 BASE ACTION

Implementation of 2024HUCH1 will ensure existing and additional funding will be available, if needed, to support research and monitoring of humpback chub in the Grand Canyon downstream of Separation Canyon.

10.6 Bonytail

Implementation of the increased reduction in flow downstream of Hoover Dam and conservation measures would affect flows and water levels in a portion of bonytail habitat along the lower Colorado River (i.e., Reaches 3 through 5). Bonytail have rarely been contacted following stockings in the lower Colorado River, and the current distribution of the species is unknown. The degree to which changes in flow reductions would affect the future distribution and status of bonytail compared to existing conditions is uncertain due to limited data on long-term survival or long-term habitat use or preference of the species in the lower Colorado River. Implementation of the increased reduction in flow and conservation measures is likely to adversely affect the bonytail. Implementation of the increased reduction in flow and conservation measures could impact bonytail critical habitat. These impacts are not expected to appreciably diminish the value of critical habitat for species conservation because impacted acres are less than 1% of the existing bonytail critical habitat in Reach 3.

10.6.1 Effects of Increased Reduction in Flow

Increased reduction in flow downstream of Hoover Dam may result in take of bonytail. For Reaches 3 through 5, impacts to backwater and riverine habitat total 109 acres for the proposed base action and 208 acres for the proposed expanded action.

Implementation of increased reduction in flow would reduce river flow in Reaches 3 through 5. Consequently, although river operations related to hydropower generation will not change (see Section 5.2.1.3 of LCR MSCP 2004b), the range of high and low flows will be lower than under existing conditions. Changes to the water elevations below Davis Dam (Reaches 3 through 5) are depicted in Table 8-1 for the proposed base action and Table 8-4 for the proposed expanded action. The decrease in river stage due to the additional reduction in flow from the proposed base action ranges from 0.04 feet to 0.48 feet in Reach 3 and from 0.03 feet to 0.81 feet in Reaches 4 and 5. The decrease in river stage due to the additional reduction in flow from the proposed expanded action range from 0.04 feet to 0.98 feet in Reach 3 and from 0.01 feet to 1.38 feet in Reaches 4 and 5. The pattern of fluctuations (daily low and high flows) does not change, and once reduced flows are implemented, no additional changes to elevations would be expected.

Bonytail have rarely been contacted following stockings in the lower Colorado River and no known spawning locations or observations of physical spawning condition or activity have been documented. The potential for stranding and desiccation cannot be estimated due to limited data on existing spawning habitat, long-term survival, or habitat use; therefore, any changes in this potential are expected to be minimal. Implementing the increased reduction in flow would however reduce river depth during what was the historic spawning period. This lower depth could reduce potential spawning habitat areas or displace stocked individuals. Bonytail prefer backwaters and occupy pools and eddies away from strong currents (Pimentel and Bulkley 1983; Vanicek 1967). Backwaters are warmer and more productive than the main river channel, potentially supporting faster growth rates. In addition, backwaters with emergent vegetation provide cover and refuge from predators. Reduced flow, and the consequent shallower depth,

could reduce feeding and nursery habitat area in the river and backwaters. Shallower depth could however result in warmer backwater habitat, increased productivity within available feeding and nursery habitat, and faster growth rates of stocked juvenile bonytail. Warmer water temperatures would also likely benefit some nonnative fish species, potentially allowing for range expansion. Ehlo (2023) reported the upstream movement of flathead catfish in Reach 3 over the last 12 years under current conditions. This expansion has not been directly linked to increasing water temperatures within the reach but may be associated with the effects of climate change, natural upstream movement of fishes, young fish dispersing to establish territory, or fish following food sources.

Based on known entrainment of razorback suckers in water diversions (Reclamation 1996), it is assumed that reductions in flow in Reach 3 may similarly entrain bonytail. Bonytail have rarely been contacted following stocking, so no conclusions can be made regarding the current level of entrainment that occurs. Entrainment of bonytail under implementation of the reduction in flow is unknown but may be similar to existing conditions (based on the area with measurable velocity toward the diversion intake); however, any entrainment of bonytail could affect the population because of its low population numbers.

Implementation of increased reduction in flow would reduce river flow in Reaches 4 and 5. Daily River fluctuation and reduced backwater depth at CHLP could displace early life stage native fishes from nursery habitat and cover, and desiccation of fish eggs could increase relative to the existing condition. Additional reduction in flow could impact 0.4 acres of open water backwater habitat at CHLP. Shallower depth could however result in warmer backwater habitat, increased productivity within available feeding and nursery habitat, and faster growth rates of stocked or resident bonytail. CHLP is hydrologically connected to the river through a porous river levee, and water exchange occurs by gravity. Temporary reductions in river stage are not expected to appreciably affect water quality or reduce the carrying capacity of the pond.

10.6.2 Effects on Critical Habitat

Implementation of increased reduction in flow downstream of Hoover Dam would not affect environmental conditions in Reach 2, including Lake Mohave. Reduction in flow is not expected to change Lake Mohave elevations, so no impacts to water quality, physical habitat, or the biological environment are expected. Therefore, critical habitat in Reach 2 would not be affected. Increased reduction in flow would affect environmental conditions in Reach 3, by changing river flow in the segment upstream of Lake Havasu and changing diversion in Lake Havasu. For critical habitat in Reach 3, impacts to backwater and riverine habitat total 13 acres for the proposed base action and 30 acres for the proposed expanded action.

Effects on critical habitat for the bonytail are confined to Reach 3 from the upper end of Havasu NWR to Parker Dam, including Lake Havasu. There is no designated critical habitat for bonytail in Reaches 4 and 5. Lake Havasu operations are not expected to change with the implementation of the increased reduction in flow. Bonytail have rarely been contacted following stockings in the lower Colorado River and no known spawning locations or observations of physical spawning condition or activity have been documented. The potential for stranding and desiccation cannot be estimated due to limited data on existing spawning habitat, long-term survival, or habitat use; therefore, any changes in this potential is expected to be minimal due to low population numbers. Implementation of increased reduction in flow would however reduce river depth during what was the historic spawning period. This lower depth could reduce potential spawning habitat area, cover, or displace stocked individuals The reduced depth could affect other primary constituent elements by reducing feeding and nursery habitat area in the river and backwaters. Shallower depth could however result in warmer backwater habitat, increased productivity within available feeding and nursery habitat, and faster growth rates of stocked juvenile bonytail. Warmer water temperatures would also likely benefit some nonnative fish species, which may increase

competition with native species. Although the increased reduction in flow may have impacts on bonytail critical habitat, the factor limiting the abundance of bonytail are competition from nonnative fish species and predation by nonnative fish species and piscivorous birds. Effects on bonytail critical habitat and predation are not expected to increase the threat from competition from nonnative fish species. The possibility, therefore, of impacts on critical habitat resulting from the increased reduction in flow is not expected to appreciably diminish the value of critical habitat for species' conservation, affect the survival of the species, nor appreciably diminish the value of critical habitat for survival of the species, for the following reasons:

- The implementation of the increased reduction in flow and the conservation measures will not diminish capacity of bonytail critical habitat present within the LCR MSCP planning area to a level that will preclude future achievement of bonytail recovery goals (USFWS 2002c).
- The LCR MSCP provides for the continued adaptive management of conservation measures to ensure that implementation of the increased reduction in flow will not diminish the value of critical habitat for conservation.
- The survival of bonytail will not be compromised by the possible effects on critical habitat resulting from increased reduction in flow because the construction and management of backwaters within designated critical habitat to provide high value bonytail habitat will replace the value of affected habitat.

10.6.3 Conservation Measures

The following conservation measures are new and will be implemented as part of the proposed action.

10.6.3.1 BASE ACTION

1. 2024BONY2 – Create 109 acres of bonytail habitat (as disconnected backwaters).
2. 2024BONY5 – Conduct monitoring and research, and adaptively manage bonytail augmentations and created habitat.
3. 2024MRM2 – Collect necessary data needed for future consultations and update existing methodologies with new information.
4. 2024MRM4 – Synthesize native fish data to inform future fish augmentation efforts and native fish habitat creation.
5. 2024MRM5 – Conduct a feasibility analysis for the construction of disconnected backwaters outside of the LCR MSCP implementation area.

10.6.3.2 EXPANDED ACTION

1. 2024AMM2 – Minimize the potential for stranding of native fishes due to reduced river stage.
2. 2024AMM3 – Minimize the impacts of reduced river stage on entrained or stranded native fishes.
3. 2024AMM4 – Minimize the impacts of reduced river stage on fish augmentation activities.

10.6.4 Effects of Conservation Measure Implementation

10.6.4.1 BASE ACTION

Implementation of the conservation measures, including creation of 109 acres of additional disconnected backwater habitat (2024BONY2), achieves the LCR MSCP goal to avoid, minimize, and fully mitigate

adverse effects of covered activities and LCR MSCP implementation on the bonytail, and to contribute to its recovery. Implementation of these measures will help ensure that the existing abundance of the species is maintained in the LCR MSCP planning area (e.g., CHLP, IPCA) and will continue to contribute towards the recovery goals established for the species (USFWS 2002c).

Implementation of 2024BONY2 will help ensure that the existing abundance of the species in the LCR MSCP planning area is maintained as a result of replacing affected habitat and will contribute to attainment of the recovery goals established for the species.

Implementation of 2024BONY5 will provide information that will contribute towards adaptively managing bonytail conservation and may also guide creation of new bonytail habitat (e.g., disconnected backwaters, and maintenance or enhancement of existing habitat).

Implementing monitoring and research measure 2024MRM2 will provide up-to-date, basin-wide backwater mapping for the purpose of updating the environmental baseline and conducting an updated impacts analysis. This analysis will use updated release schedules based on current operating criteria of lower Colorado River dams. Assumptions used in all previous analyses will be reviewed and updated to improve the impact analysis.

Implementing monitoring and research measure 2024MRM4 will help to determine the potential value of the native fish augmentation program. As data have yet to be synthesized, the results from this measure may provide other valuable data that can be used to manage further stocking efforts and potentially improve the LCR MSCP fish augmentation strategy with the goal of maximizing post-stocking survival of native fishes.

Implementation of conservation measure 2024MRM5 will provide information that will contribute towards adaptively managing bonytail conservation and may also guide creation of new bonytail habitat (e.g., disconnected backwaters, and maintenance or enhancement of existing habitat).

10.6.4.2 EXPANDED ACTION

Implementing the avoidance and minimization measure 2024AMM2 will help to reduce the risk of stranding fish as water levels drop in the river and backwaters potentially become isolated from the mainstem river. This measure would also provide contingencies if backwaters become isolated pools, through monitoring and maintaining water quality to ensure survival of fishes. Maintaining the water supply to ensure backwaters remain connected protects important nursery habitat and ultimately aids in survival. Additionally, providing a contingency plan to rescue native fishes and remove nonnative fishes further aids in conserving populations of native fishes.

Implementing avoidance and minimization measure 2024AMM3 will help to reduce risk of stranding of fishes as water levels drop in backwaters. This measure would also provide contingencies for maintaining water quantity and quality to ensure survival of fishes. Monitoring off-channel infrastructure would also help to reduce the risk of permanent displacement due to entrainment. Coordinated rescue efforts would help to ensure conservation of isolated and mainstem native fish populations. This measure would help to further increase survival and recruitment into the adult population.

Implementing avoidance and minimization measure 2024AMM4 provides protection of recently stocked fishes and will help in increasing survival of these fishes.

10.7 Razorback Sucker

Implementation of the increased reduction in flow downstream of Hoover Dam and conservation measures could affect razorback sucker habitat in the action area. Impacts in Reaches 1 and 2 are anticipated to be no larger than what was analyzed in the 2005 BO (USFWS 2005a). Impacts in addition to what was analyzed in the 2005 BO are anticipated in a portion of Reaches 3-5. The degree to which changes in flow reductions would affect the future distribution and status of razorback sucker in Reach 3 compared to existing conditions is uncertain. Under current conditions, adult razorback suckers move and use both riverine and backwater habitat at various river stages. It is expected that adult razorback suckers would move to suitable habitat under reduced flows. Under certain low-flow scenarios in Reaches 4 and 5, razorback suckers would likely be temporarily displaced from edge habitat in the river and backwaters. Implementation of the increased reduction in flow and conservation measures is likely to adversely affect the razorback sucker. Implementation of the increased reduction in flow and conservation measures could impact razorback sucker critical habitat.

10.7.1 Effects of Increased Reduction in Flow

The increased reduction in flows downstream of Hoover Dam may result in take of razorback sucker from Lake Mead. For Reaches 1 and 2, these effects are not anticipated to be larger than what was analyzed in the 2005 BO (USFWS 2005a). For Reaches 3 through 5, impacts to backwater and riverine habitat total 109 acres for the proposed base action and 208 acres for the proposed expanded action.

Implementation of the increased reductions in flow downstream of Hoover Dam would reduce river flow in river reaches below the dam. Consequently, although river operations related to hydropower generation will not change (see Section 5.2.1.3 of LCR MSCP 2004b), the range of high and low flows will be lower than under existing conditions. Changes to the water elevations below Davis Dam (Reaches 3 through 5) are depicted in Table 8-1 for the proposed base action and Table 8-4 for the proposed expanded action. The decrease in river stage due to the additional reduction in flow from the proposed base action range from 0.04 feet to 0.48 feet in Reach 3 and from 0.03 feet to 0.81 feet in Reaches 4 and 5. The decrease in river stage due to the additional reduction in flow from the proposed expanded action range from 0.04 feet to 0.98 feet in Reach 3 and from 0.01 feet to 1.38 feet in Reaches 4 and 5. The result of these changes is not substantial compared to existing conditions. The change in the potential for stranding and desiccation, therefore, is expected to be minimal.

Razorback suckers require clean gravel in shallow areas of quiet water for spawning from January through April/May (Langhorst and Marsh 1986). Implementing increased reduction in flow would reduce river depth during the spawning period. The reduced depth could reduce existing and potential spawning habitat area; however, new, suitable spawning habitat may also be exposed at lower elevations. Under declining elevations in Lake Mead, razorback suckers have continually shifted spawning sites each year, finding suitable habitat adjacent to spawning locations identified in previous years (Rogers et al. 2023). The purpose of the proposed action is to maintain or increase Lake Mead elevations. So, while existing and potential spawning habitat areas could be affected by increased reduction in flow, it is not expected that all spawning habitat or reproductive potential would be lost. Connected backwaters and low-velocity channel types, such as pool edges and side channels, provide rearing habitat for larval and stocked juvenile razorback suckers. Stocked razorback suckers show a preference for backwaters over the main channel habitats (Mueller and Marsh 1998). Backwaters are warmer and more productive than the main river channel, potentially supporting faster growth rates. In addition, backwaters with emergent vegetation provide cover and potential refuge from predators. Reduced flow, and the resulting shallower depth, could reduce feeding and nursery habitat area in the river and backwaters. It is not expected that reduced flow would appreciably affect water quality in the river or backwaters as daily fluctuations would still facilitate movement of water within these habitats. Stolberg (2009) observed successful egg hatch and larval

development of razorback suckers at dissolved oxygen concentrations as low as 3 milligrams per liter, suggesting that even under what would be uncommon natural conditions during the known spawning season for the species in the lower Colorado River, total reproductive potential may not be lost. Shallower depth could also result in warmer backwater habitat, increased productivity within available feeding and nursery habitat, and faster growth rates of larval and juvenile stocked razorback suckers. Warmer water temperatures would also likely benefit some nonnative fish species. Ehlo (2023) reported the upstream movement of flathead catfish in Reach 3 over the last 12 years under current conditions. This expansion has not been directly linked to increasing water temperatures within the reach but may be associated with the effects of climate change, natural upstream movement of fishes, young fish dispersing to establish territory, or fish following food sources.

10.7.2 Effects on Critical Habitat

The reduction in flows downstream of Hoover Dam could impact critical habitat in Reaches 3 through 5; 96 acres of backwater and riverine habitat for the proposed base action and 162 acres for the proposed expanded action. Designated critical habitat for razorback sucker within the action area consists of

- the Colorado River and its 100-year floodplain from Hoover Dam to Davis Dam, including Lake Mohave up to its full-pool elevation (i.e., Reach 2); and
- the Colorado River and its 100-year floodplain from Parker Dam to Imperial Dam, including Imperial Reservoir to the full-pool elevation or 100-year floodplain, whichever is greater (i.e., Reaches 4 and 5).

Implementation of the increased reductions in flow would not affect Reach 1 (Lake Mead) beyond the effects already analyzed in the original 2005 LCR MSCP BO. While spawning habitat for razorback suckers has been periodically affected by changes in lake elevation over the last 18 years (2005–2022), razorback suckers have successfully moved their spawning locations to adjacent areas at progressively lower elevations as the lake receded and have moved back to previously used spawning locations in years when lake elevation increased (Albrecht et al. 2013). Additionally, the purpose of the proposed action is to maintain or increase Lake Mead elevations. Elevation changes occur slowly throughout the spawning season and the remainder of the year, reducing the likelihood of other impacts (e.g., stranding). Razorback sucker recruitment has been documented in Lake Mead every year from 2005 through 2020 despite changing reservoir elevations (Rogers et al. 2023). The purpose of the proposed action (reduction in flows in Reaches 2 through 5) is to increase storage (and reservoir elevations) in Lake Mead. This action would not create conditions outside of those observed in recent years and may be advantageous for successful recruitment by providing flooded terrestrial vegetation as additional cover for the young fish (Golden and Holden 2002; Welker and Holden 2003).

Implementation of the increased reductions in flow would not affect environmental conditions in Reach 2, including Lake Mohave. Reduction in flow is not expected to change Lake Mohave elevations, so no impacts to water quality, physical habitat, or the biological environment are expected. Therefore, critical habitat in Reach 2 would not be affected.

Implementation of increased reduction in flow would reduce river flow in Reaches 4 and 5. The decreases in river stage due to the additional reduction in flow differ seasonally and range from 0.03 feet to 0.81 feet within this designated critical habitat for the proposed base action and range from 0.01 feet to 1.38 feet for the proposed expanded action. Implementing increased reduction in flow would impact 56 acres of backwater and 40 acres of river habitat for the proposed base action and 114 acres of backwater and 65 acres of river habitat for the proposed expanded action. This reduction in flow would reduce potential spawning habitat, feeding and nursery habitat, and edge habitat in the river and backwaters. Daily River fluctuation would also reduce backwater depth at CHLP, which could displace early life stage native

fishes from nursery habitat and cover. Desiccation of fish eggs could also increase relative to the existing condition. Additional reduction in flow could impact 0.4 acres of open water backwater habitat at CHLP. The shallower depth could, however, result in warmer backwater habitat, increased productivity within available feeding and nursery habitat, and faster growth rates of stocked or resident bonytail. CHLP is hydrologically connected to the river through a porous river levee and water exchange occurs by gravity. Temporary reductions in river stage are not expected to appreciably affect water quality or reduce the carrying capacity of the pond. Cross-sectional data for river mile 96.2 (adjacent to CHLP) with minimum and maximum daily water elevations at the 2.083 maf reduction is provided in Figure 10-1 for reference.

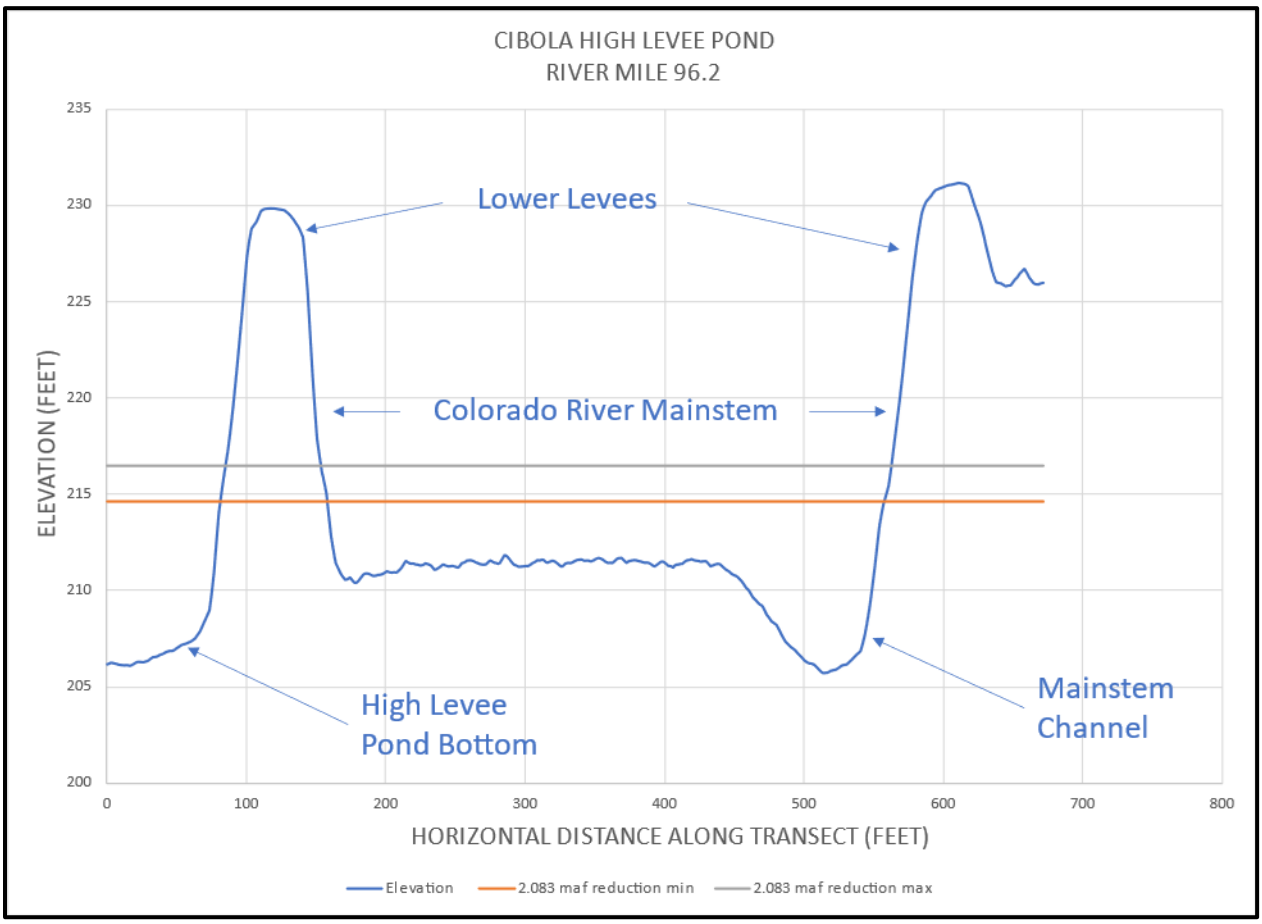


Figure 10-1. River cross-section at river mile 96.2, CHLP, LCR MSCP Reach 4.

10.7.3 Conservation Measures

The following conservation measures are new and will be implemented as a result of the proposed action.

10.7.3.1 BASE ACTION

1. 2024RASU2 – Create 109 acres of razorback sucker habitat (as disconnected backwaters).
2. 2024RASU7 – Provide funding and support for continuation of the ongoing Lake Mead razorback sucker studies.
3. 2024MRM2 – Collect necessary data needed for future consultations and update existing methodologies with new information.

4. 2024MRM4 – Synthesize native fish data to inform future fish augmentation efforts and native fish habitat creation.
5. 2024MRM5 – Conduct a feasibility analysis for the construction of disconnected backwaters outside of the LCR MSCP implementation area.

10.7.3.2 EXPANDED ACTION

1. 2024AMM2 – Minimize the potential for stranding of native fishes due to reduced river stage.
2. 2024AMM3 – Minimize the impacts of reduced river stage on entrained or stranded native fishes.
3. 2024AMM4 – Minimize the impacts of reduced river stage on fish augmentation activities.

10.7.4 Effects of Conservation Measure Implementation

10.7.4.1 BASE ACTION

Implementation of the conservation measures, including creation of 109 acres of additional disconnected backwater habitat (2024RASU2), achieves the LCR MSCP goal to avoid, minimize, and fully mitigate adverse effects of covered activities for razorback sucker. Also these contribute tothe LCR MSCP implementation on the razorback sucker and contribute to its recovery. Implementation of these measures will help ensure that the existing abundance of the species is maintained in the LCR MSCP planning area (e.g., CHLP, IPCA) and will continue to contribute towards the recovery goals established for the species (USFWS 2002d).

Implementation of 2024RASU2 will help ensure that the existing abundance of the species in the LCR MSCP planning area is maintained as a result of replacing affected habitat and will contribute to attainment of the recovery goals established for the species.

Implementation of 2024RASU7 will allow for additional data to be collected during the interim coverage period that will be analyzed and used to inform the post-2026 consultation, future conservation strategies, and future data collection efforts.

Implementing monitoring and research measure 2024MRM2 will provide up-to-date, basin-wide backwater mapping for the purpose of updating the environmental baseline and conducting an updated impacts analysis. This analysis will use updated release schedules based on current operating criteria of lower Colorado River dams. Assumptions used in all previous analyses will be reviewed and updated to improve the impact analysis.

Implementing monitoring and research measure 2024MRM4 will help to determine the potential value of the native fish augmentation program. As data have yet to be synthesized, the results from this measure may provide other valuable data that can be used to manage further stocking efforts and potentially improve the LCR MSCP fish augmentation strategy with the goal of maximizing post-stocking survival of native fishes.

Implementing monitoring and research measure 2024MRM5 will provide information that will contribute towards adaptively managing razorback sucker conservation and may also guide creation of new razorback sucker habitat (e.g., backwaters, and maintenance or enhancement of existing habitat).

10.7.4.2 EXPANDED ACTION

Implementing avoidance and minimization measure 2024AMM2 will help to reduce the risk of stranding of fish as water levels drop in the river and backwaters potentially become isolated from the mainstem river. This measure would also provide contingencies if backwaters become isolated pools, through monitoring and maintaining water quality to ensure survival of fishes. Maintaining the water supply to ensure backwaters remain connected protects important nursery habitat and ultimately aids in survival. Additionally, providing a contingency plan to rescue native fishes and remove nonnative fishes further aids in conserving populations of native fishes.

Implementing avoidance and minimization measure 2024AMM3 will help to reduce risk of stranding of fishes as water levels drop in backwaters. This measure would also provide contingencies for maintaining water quantity and quality to ensure survival of fishes. Monitoring off-channel infrastructure would also help to reduce the risk of permanent displacement due to entrainment. Coordinated rescue efforts would help to ensure conservation of isolated and mainstem native fish populations. This measure would help to further increase survival and recruitment into the adult population.

Implementing avoidance and minimization measure 2024AMM4 provides protection of recently stocked fishes and will help in increasing survival of these fishes.

11 CUMULATIVE EFFECTS

Cumulative effects are defined under ESA regulations as those effects of future state or private activities, not involving federal activities, that are reasonably certain to occur within the action area of the federal action subject to consultation. Section 6 of the 2004 BA includes an analysis of cumulative effects from a range of future actions. Since these future actions have not changed, the prior analysis is adopted by reference, and there would be no additional cumulative effects (see Section 6 of LCR MSCP 2004b).

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ATTACHMENT 1

Bathymetry Graphs of Razorback Sucker Spawning Locations

Bathymetry Graphs of Razorback Sucker Spawning Locations Under the 2.083 mafy Reduction Scenario

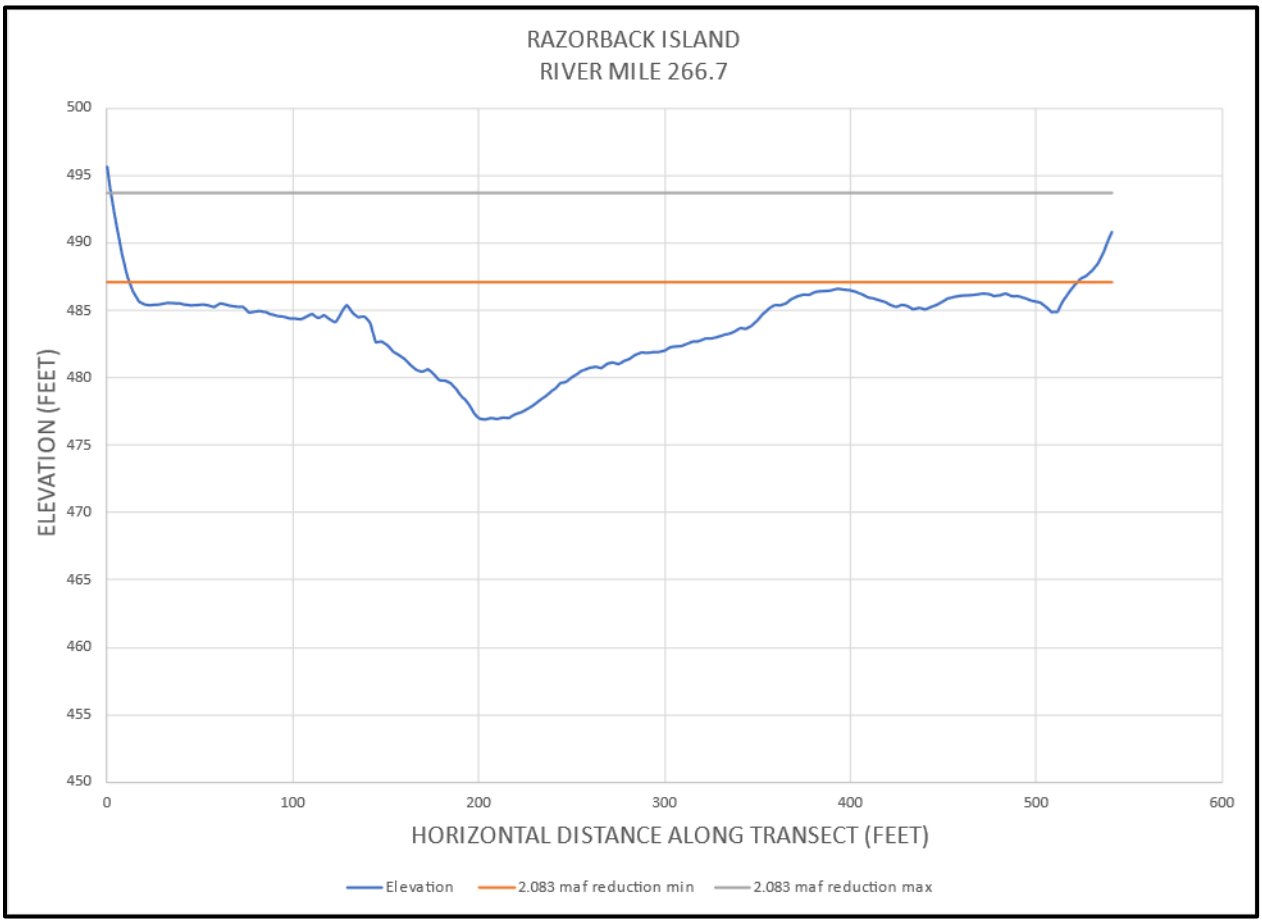


Figure A1-1. Bathymetry at river mile 266.7

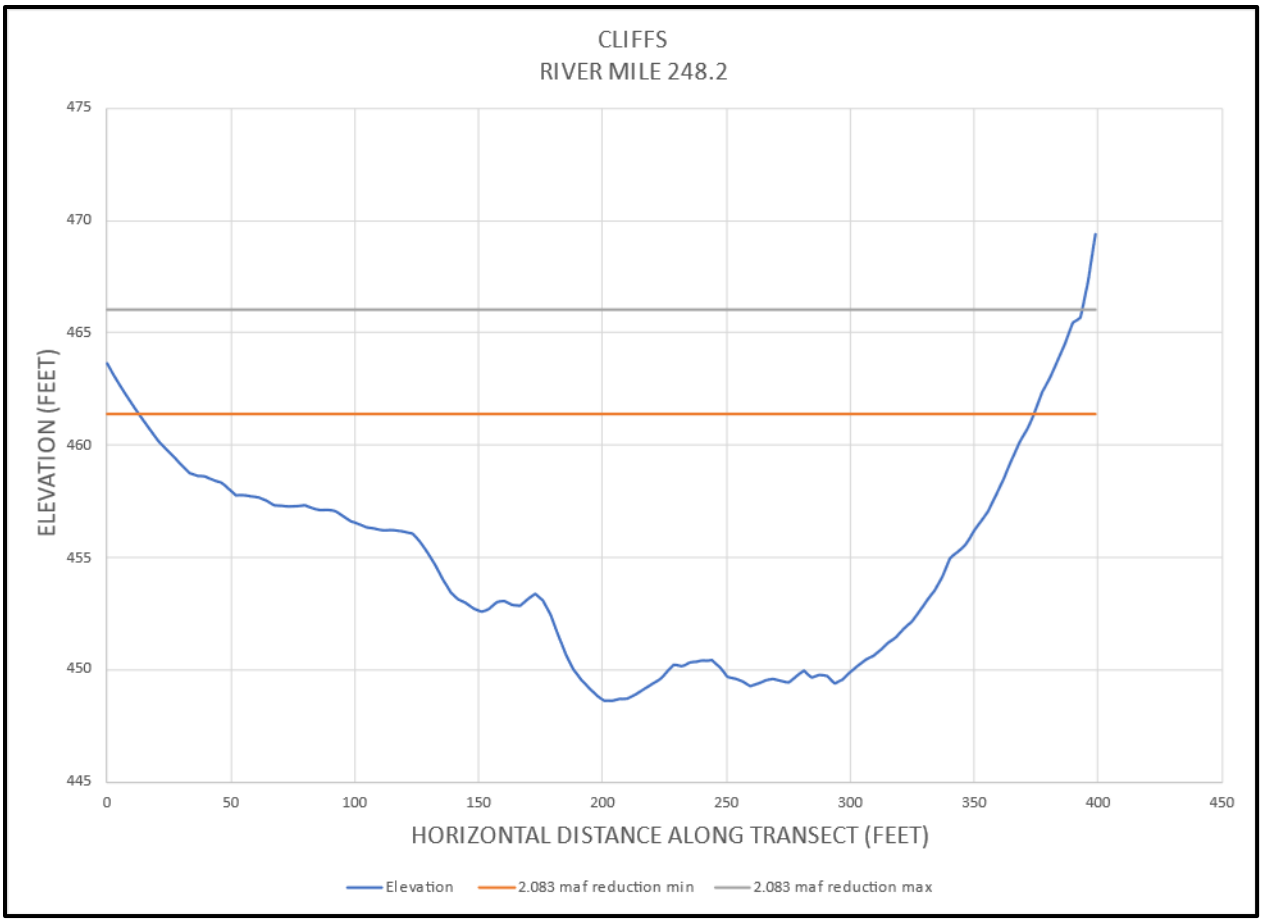


Figure A1-2. Bathymetry at river mile 248.2

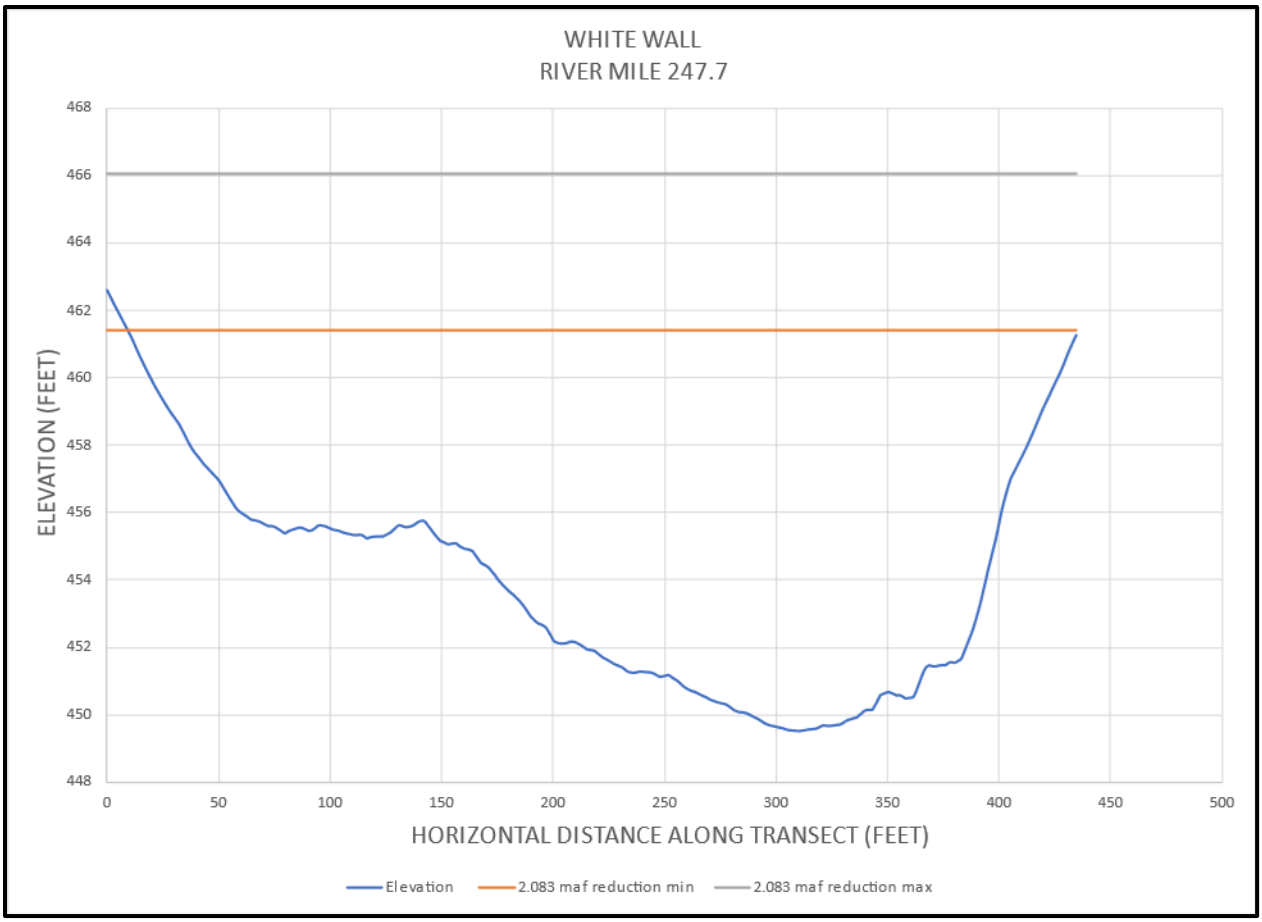


Figure A1-3. Bathymetry at river mile 247.7

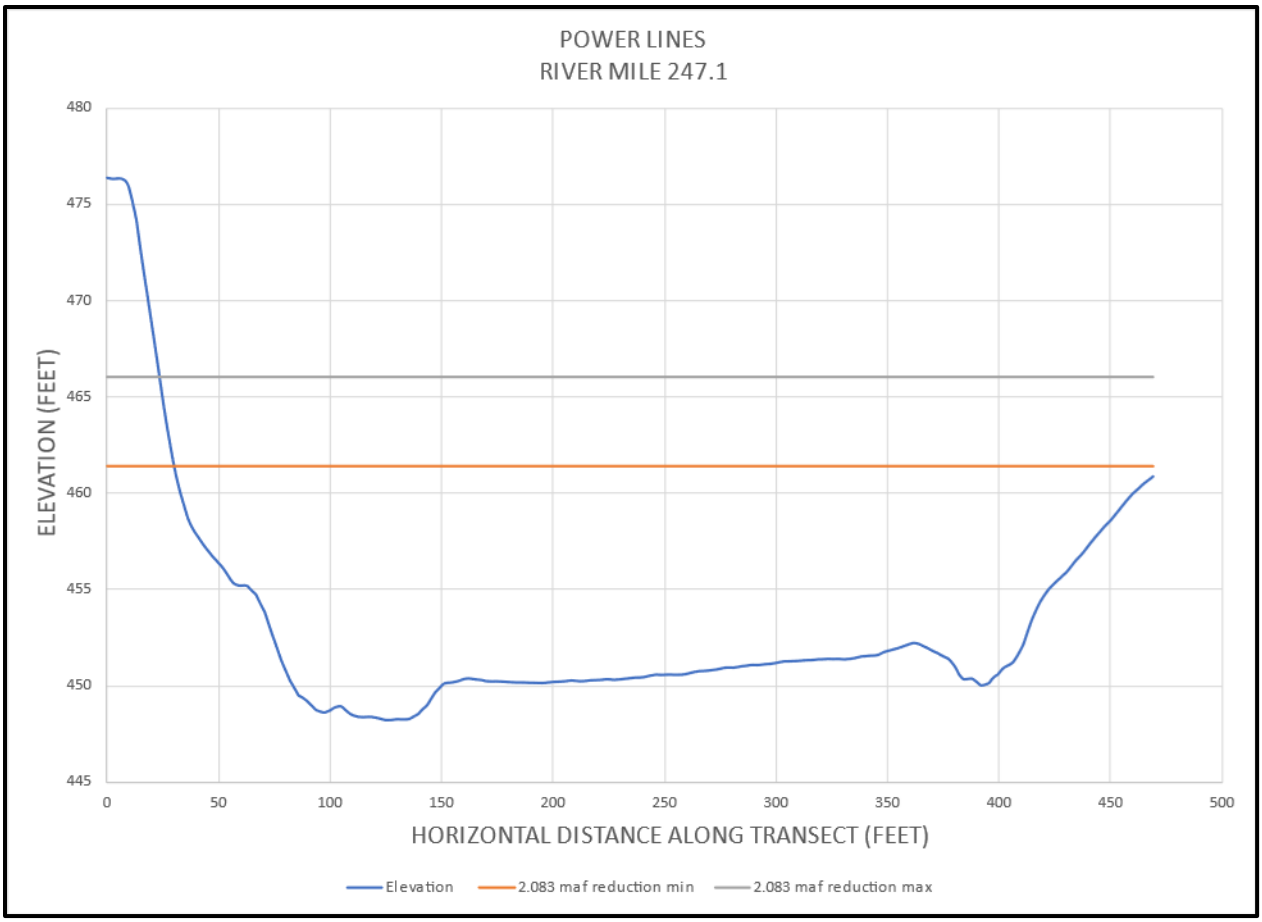


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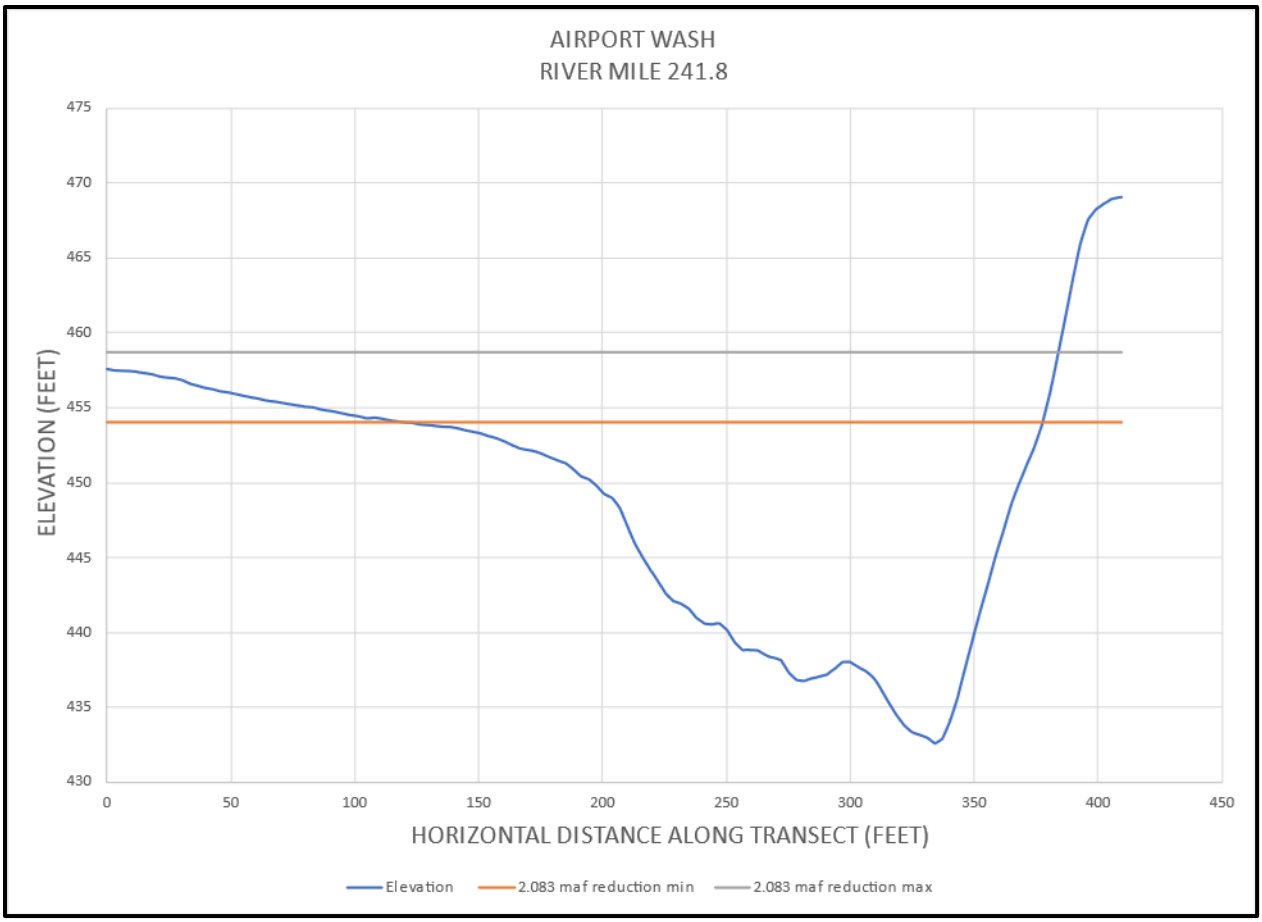


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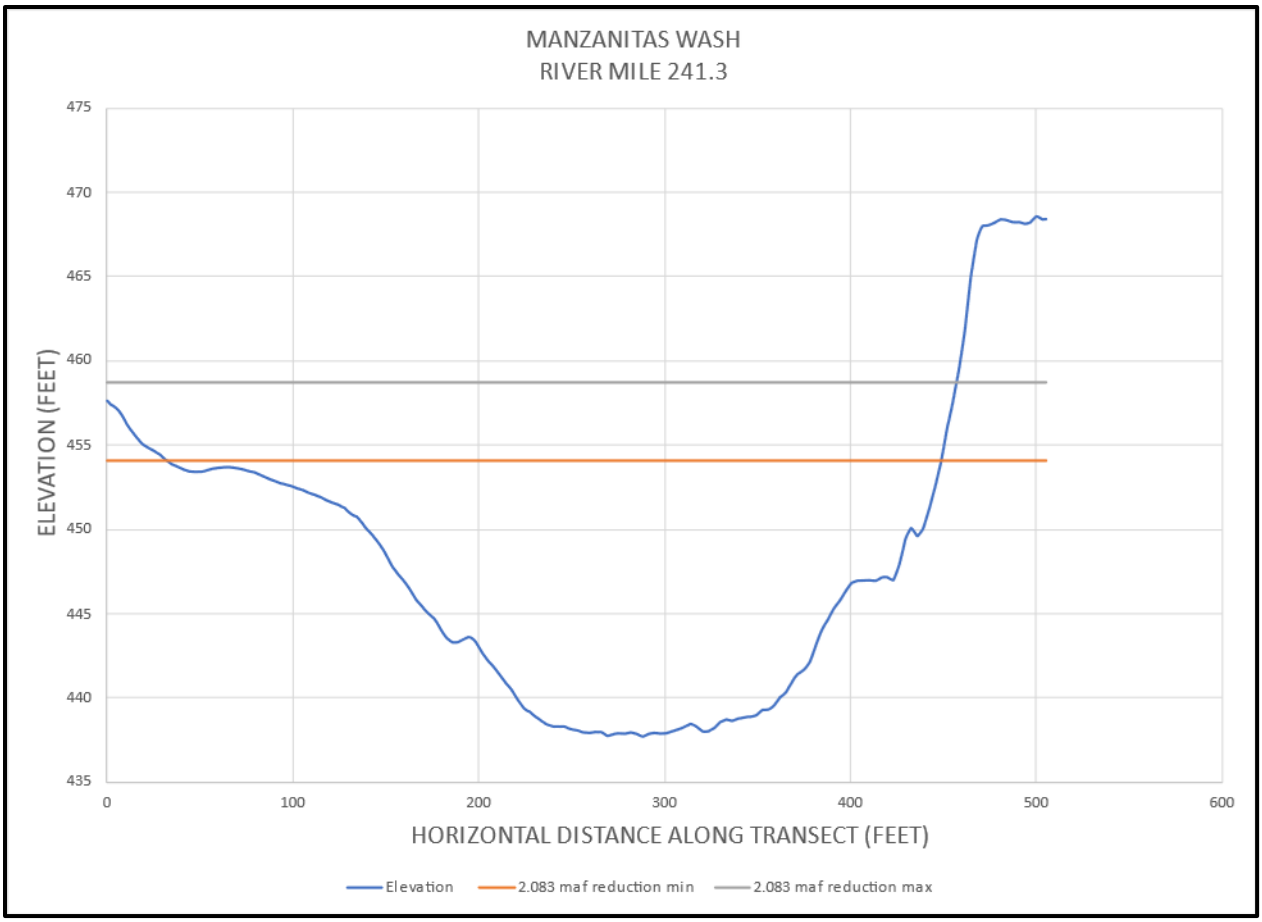


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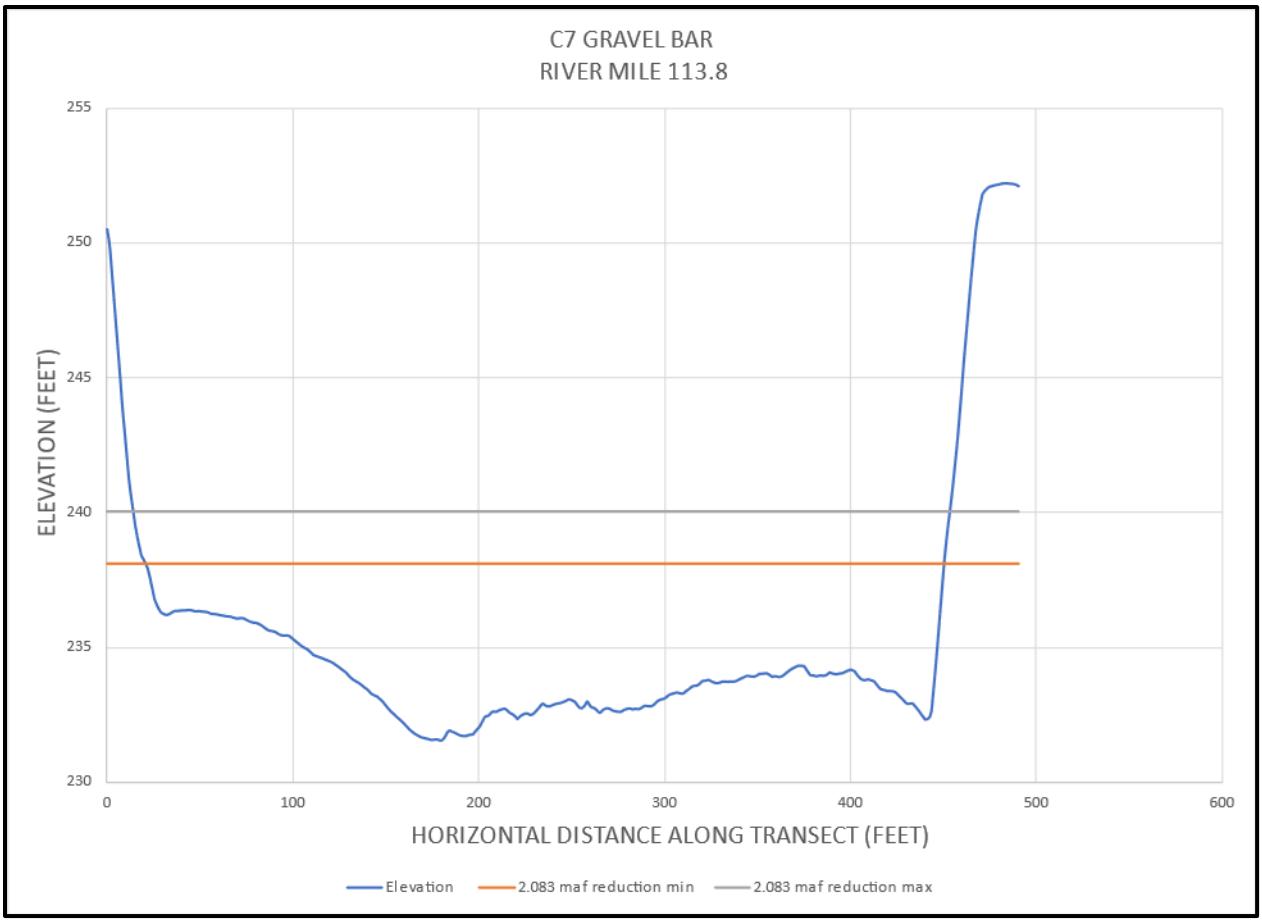


Figure A1-7. Bathymetry at river mile 113.8

Bathymetry Graphs of Razorback Sucker Spawning Locations Under the 3.0 mafy Reduction Scenario

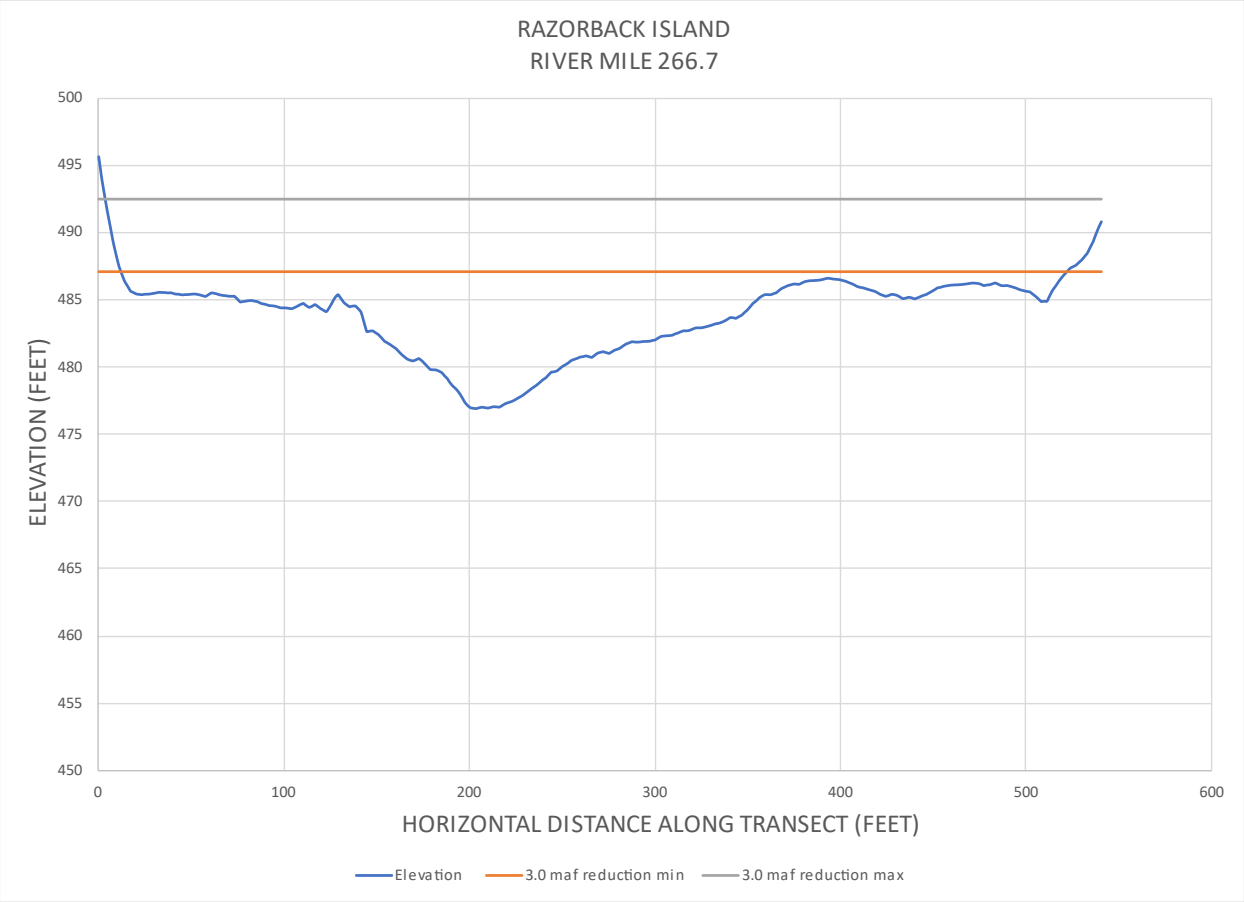


Figure A1-8. Bathymetry at river mile 266.7

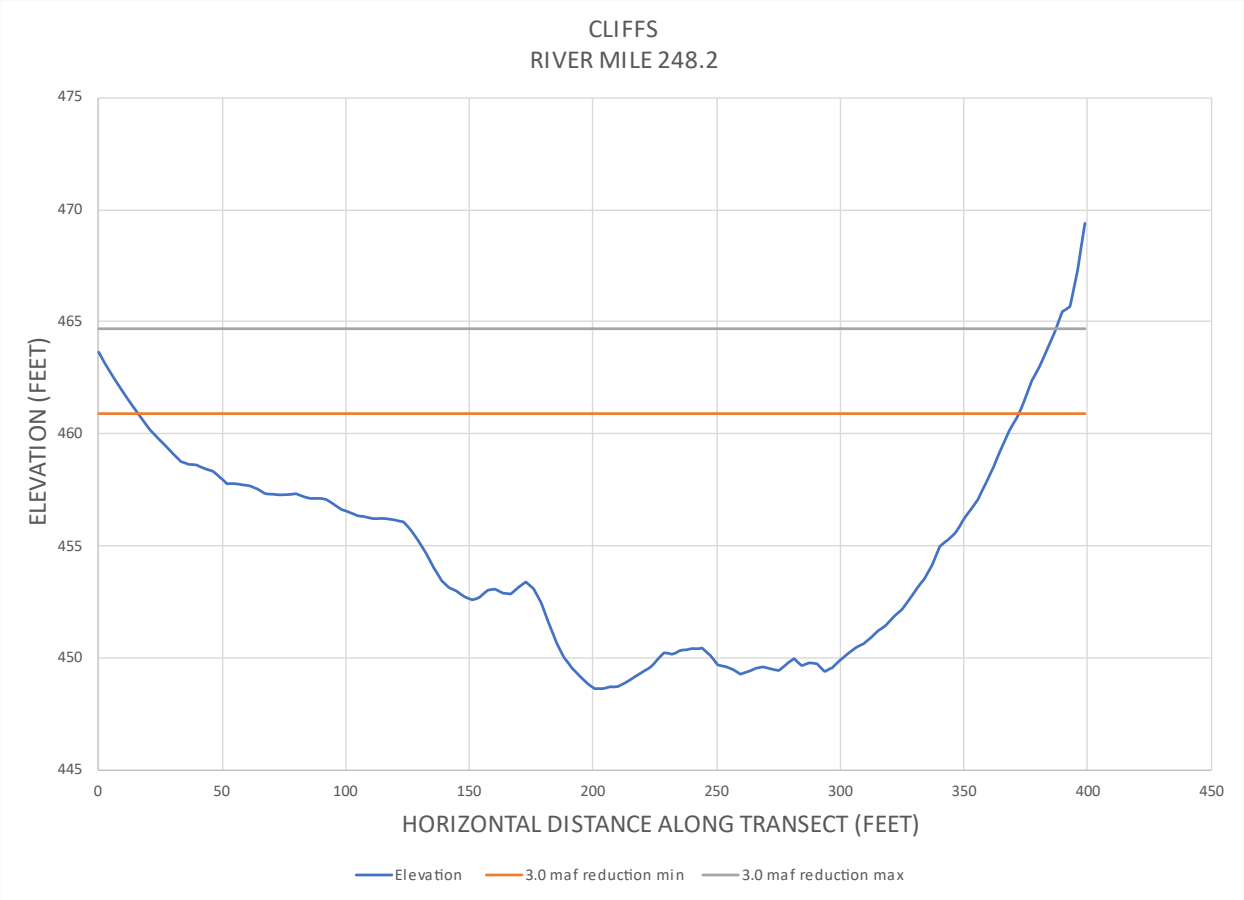


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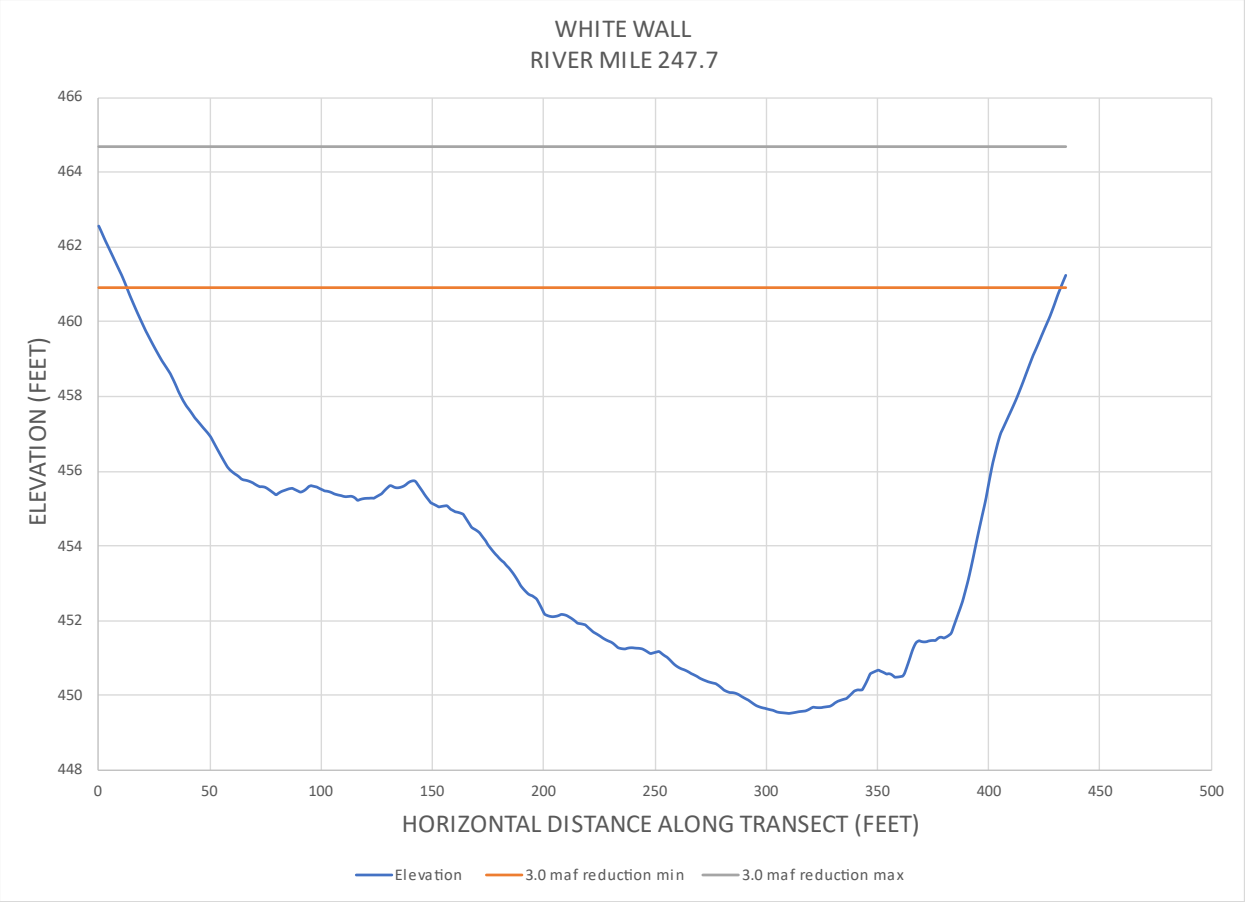


Figure A1-10. Bathymetry at river mile 247.7

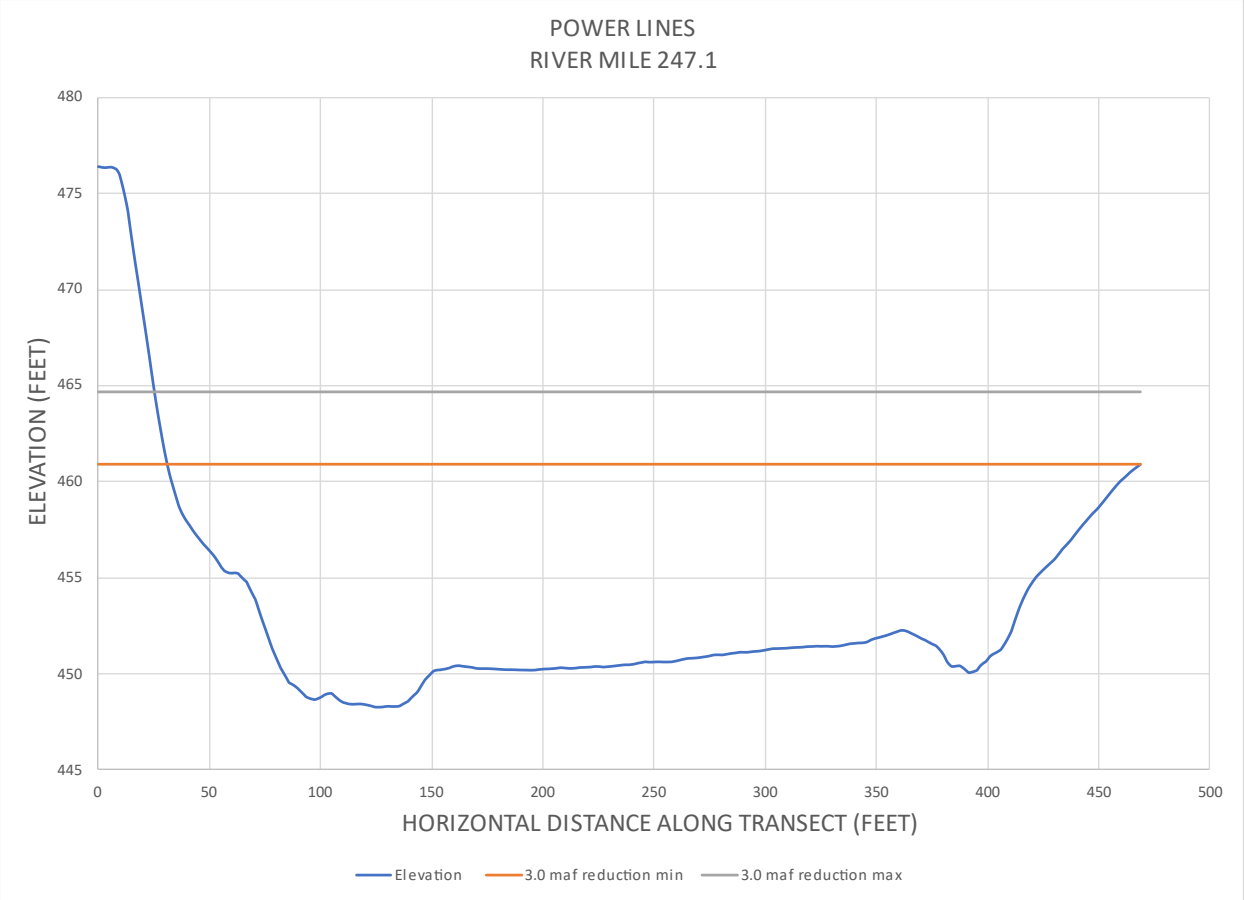


Figure A1-11. Bathymetry at river mile 247.1

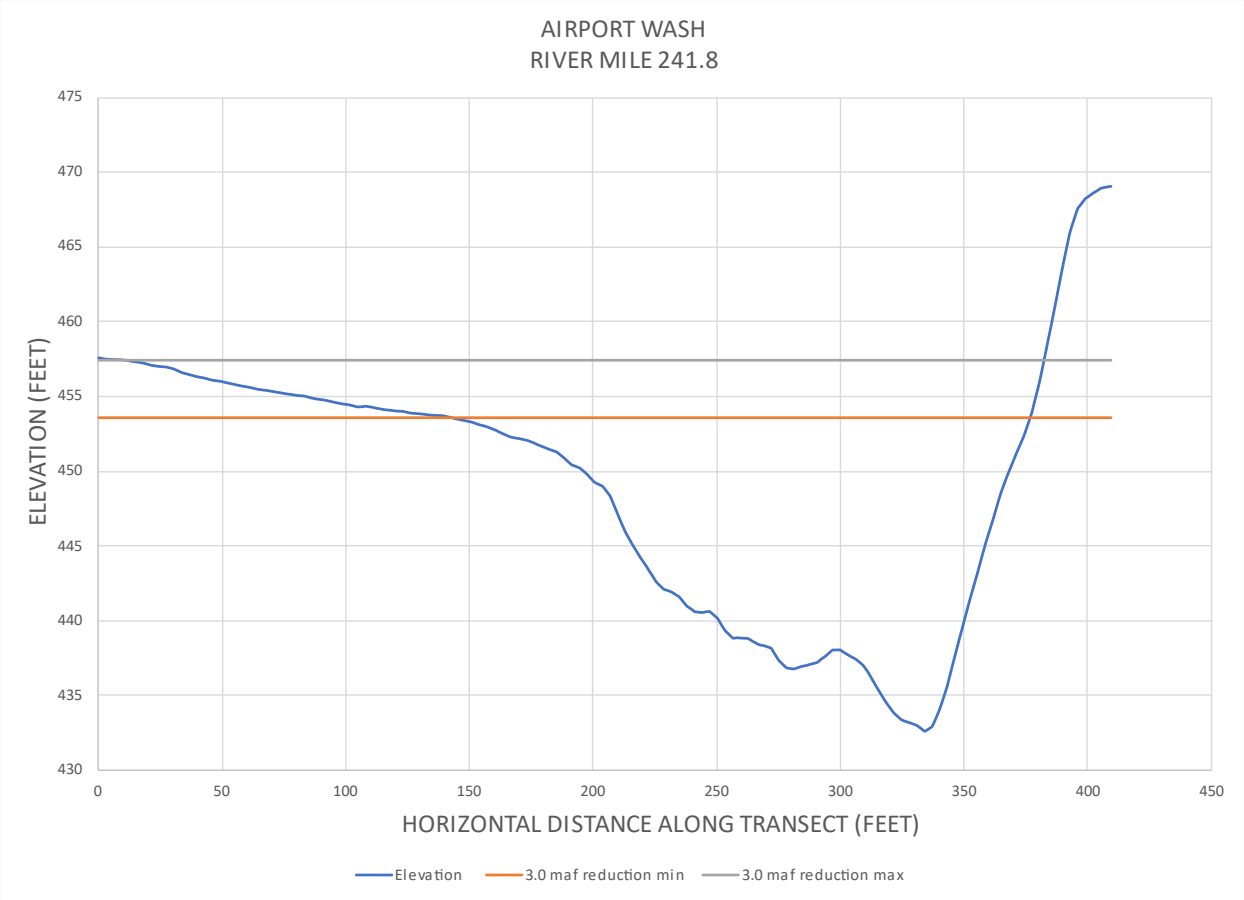


Figure A1-12. Bathymetry at river mile 241.8

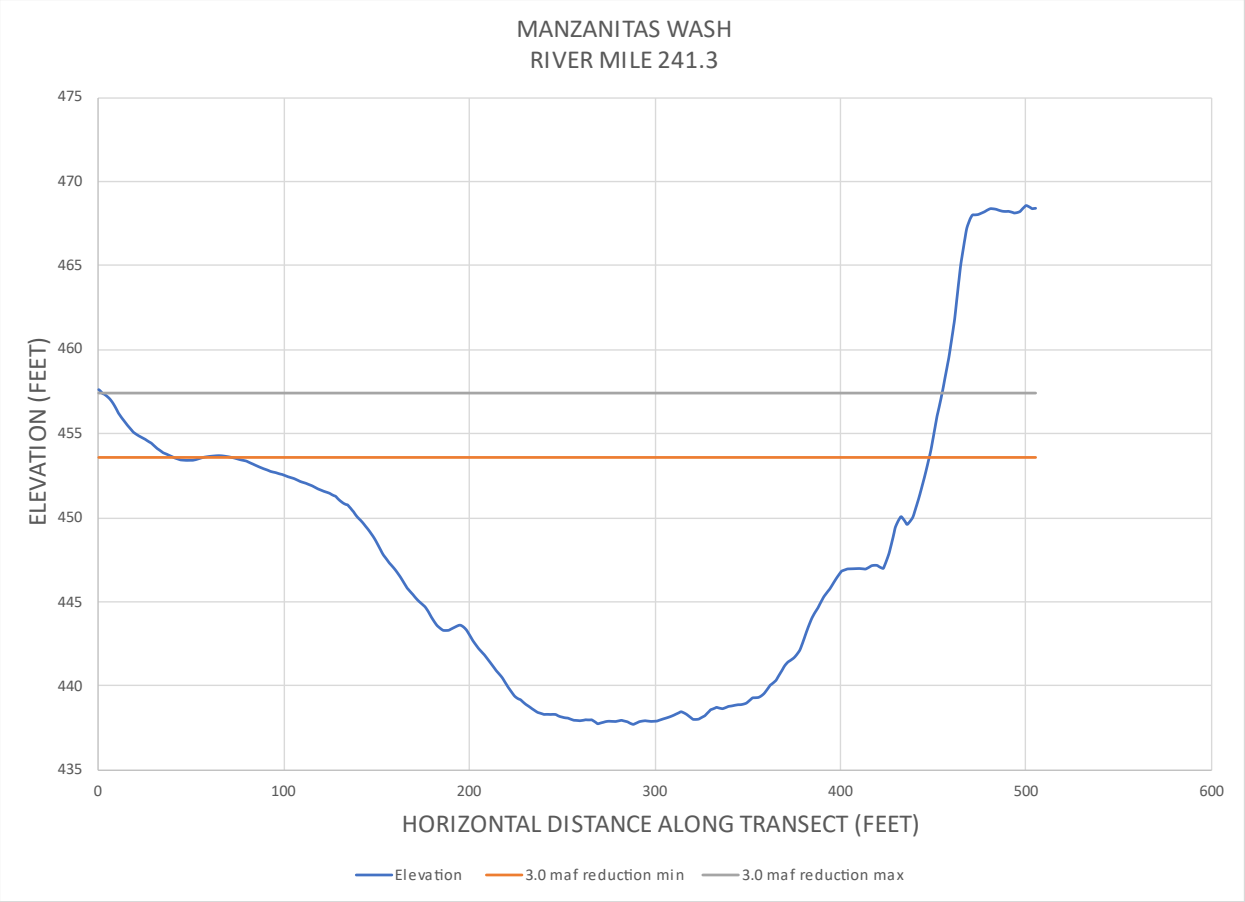


Figure A1-13. Bathymetry at river mile 241.3

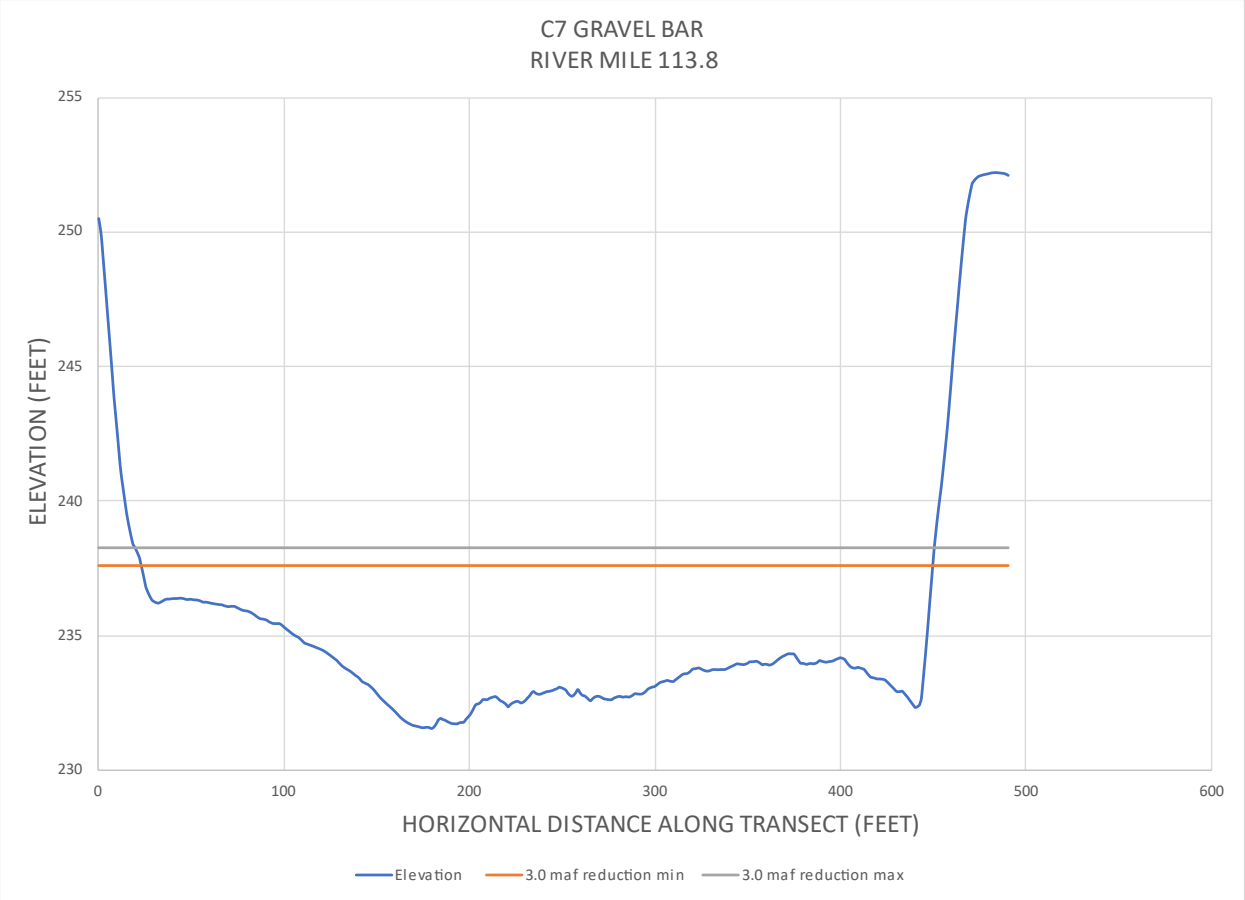


Figure A1-14. Bathymetry at river mile 113.8

ATTACHMENT 2

Comparison of 2004 and 2020 Aerial Imagery for Select Backwaters

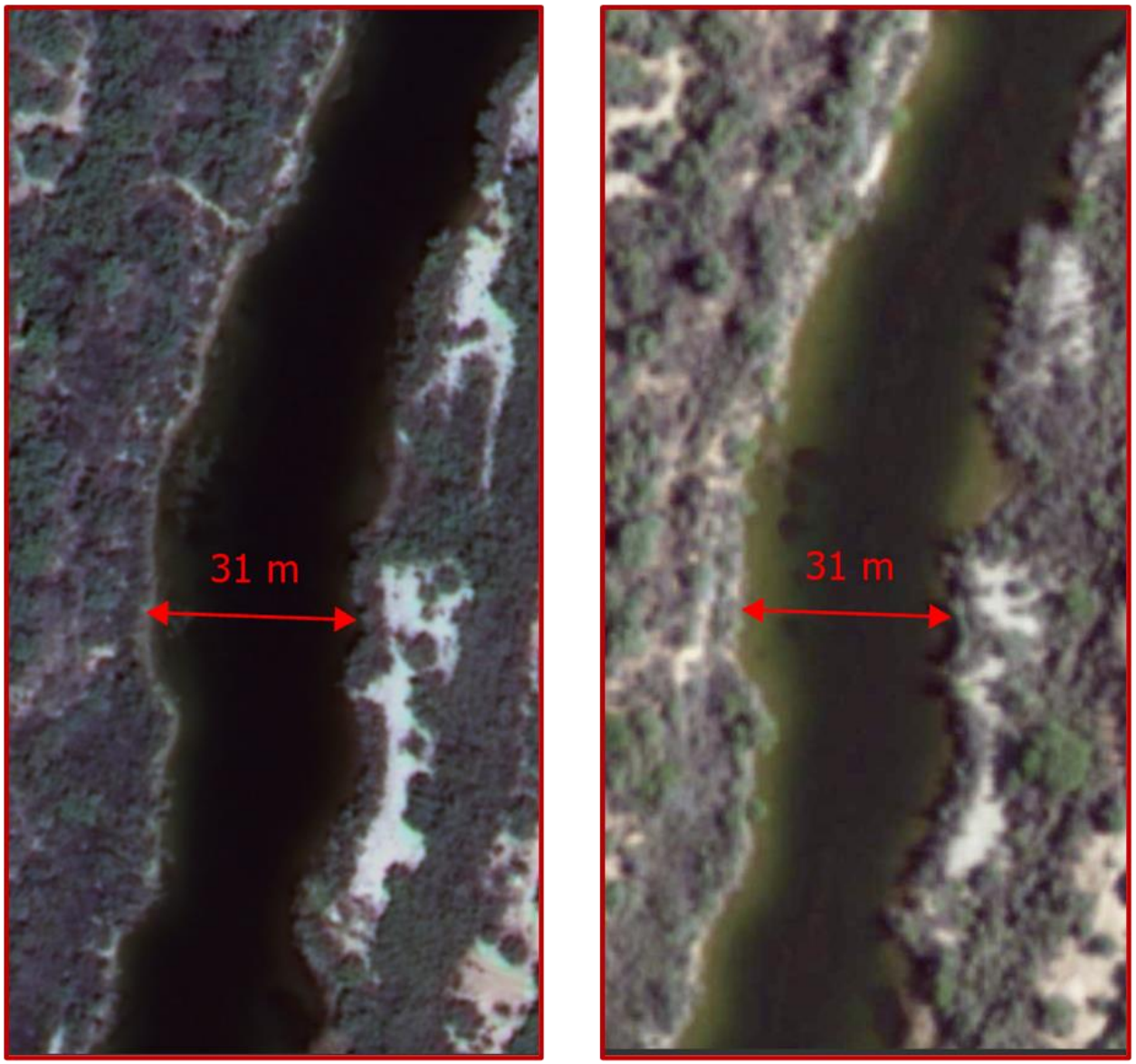


Figure A2-1. A10 backwater at River Mile 114.4. Left image shows 2004 aerial imagery. Right image shows 2020 aerial imagery.



Figure A2-2. Beal Slough backwater at River Mile 237.8. Left image shows 2004 aerial imagery. Right image shows 2022 aerial imagery.

ATTACHMENT 3

Other LCR MSCP Reaches and Effects

Reach 6 River Conditions Imperial Dam to Morelos Dam

The LCR MSCP did not specifically account for flow reductions between Imperial Dam and Morelos Dam (Reach 6) because hydrologic impacts of the future flow-related actions were determined to be insignificant. River flows in Reach 6 are dominated by drainage return flows and not releases from upstream reservoirs. Most of the Colorado River water delivered to Morelos Dam is diverted at Imperial Dam, routed through the All-American Canal, then returned to the river through either Siphon Drop or Pilot Knob power plants, which are located upstream from Morelos Dam.

The lower end of Reach 6, from Siphon Drop downstream to Morelos Dam, is characterized by steep banks leading into desert vegetation, developed areas, or areas completely denuded of vegetation. Riparian and marsh habitats are nonexistent to the extent needed to support LCR MSCP terrestrial species. Native fish habitat in the lower portion of Reach 6 of the Colorado River has been degraded due to a variety of human influences and nonnative fish presence. Field surveys conducted for game fish have not detected the presence of razorback sucker or bonytail. Increases in reductions in flow between Hoover and Imperial Dams (Reaches 2 through 5) would have no effect on LCR MSCP species in Reach 6.

Reach 7 Effects

Appendix L of LCR MSCP (2004c) describes the methodology used to analyze impacts to resources in Reach 7 and the results. Section L.5 states the following,

> "*In summary, there are only minor differences in the potential magnitudes and potential frequencies of excess flows between baseline conditions and the analyzed alternative. These differences are not expected to be significant.*"

Increases in reductions in flow between Hoover and Imperial Dams (Reaches 2 through 5) do not change the summary as stated above.

ATTACHMENT 4

Other Threatened and Endangered Species and Effects

Other Threatened and Endangered Species	Reason for No Effect from Increased Reduction in Flow in Reaches 2 through 5
Desert tortoise *Gopherus agassizii*	The desert tortoise was listed as threatened in 1990 and critical habitat was designated in 1994 (*Federal Register* 59:5820–5866). Critical habitat includes portions of southwest Utah, southeast Nevada, western Arizona, and southeast California. The species is not affected by flow-related covered activities in this BA.
Desert pupfish *Cyprinodon macularius*	The desert pupfish was listed as endangered in 1986. Critical habitat was designated in 1986 and includes Imperial County, California and Pima County, Arizona (*Federal Register* 51:10842). In 1993, the USFWS approved the Desert Pupfish Recovery Plan (USFWS 1993). The desert pupfish is native to the southwestern United States, including springs and marshes along the lower Colorado River. It is currently held in contained ponds at the Cibola National Wildlife Refuge. The desert pupfish is not currently in any habitat that may be affected by operations of the Colorado River.
Woundfin *Plagopterus argentissimus*	The woundfin was listed as endangered October 13, 1970 (*Federal Register* 35:16047), and critical habitat was designated together with the endangered Virgin River chub on January 26, 2000 (*Federal Register* 65:4140-4156). Critical habitat includes the mainstem Virgin River and its 100-year floodplain, from the confluence of La Verkin Creek, Utah, to Halfway Wash, Nevada. Critical habitat on the Virgin River extends to about 17 miles upstream of its confluence with the Muddy River, which is about 6 miles upstream of the full pool elevation of Lake Mead. Woundfin are not found in the Virgin River downstream of Mesquite, Nevada or in any other location of the lower Colorado River.
Virgin River chub *Gila seminuda*	The Virgin River chub (*Gila seminuda*) was listed as endangered on August 24, 1989 (*Federal Register* 54:35305), and critical habitat was designated together with the endangered woundfin on January 26, 2000 (*Federal Register* 65:4140). The historical range of the Virgin River chub included the Virgin River and Muddy River in Utah, Arizona, and Nevada. Designated critical habitat for the Virgin River chub is identical to that previously described for the woundfin (*Federal Register* 65:4140-4156). The Virgin River chub is not found within the full pool elevation of Lake Mead or in any other location of the lower Colorado River.